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BRITISH PESSIMISM.

One often hears about British conceit and bumptiousness, but it may be questioned whether any people in the world are so frank in dealing with their own real or supposed shortcomings as the English have always been. Mr. Kilburn Scott's article in this issue on electrical conditions in England is a case in point. His criticisms of his fellow countrymen are cynical and almost brutal. We doubt their entire accuracy, but cannot help thinking that where there is such readiness to see the need of improvement, changes for the better cannot be far off. The cocksure spirit that is so often manifested on this side of the water might well be mitigated by a little of this British humility and readiness to learn when the error or defect is seen.

THE COST OF TELEPHONY.

We had occasion to point out recently that the *New York Times*, in comparing the cost of telephony in Stockholm with the cost in New York, did not deal accurately or fairly with the facts in the case, and now the *Times* returns to the charge, with the suggestion that it might "find cause for adverse criticism in its (our) disingenuous presentation of the facts." As to this view of us, we will simply remark that the *Times* alleged that there are only 40,000 telephone stations in New York City, all at $240. Putting aside, without comment, the number, which really happens to be 60,000, all told, we pointed out that only 1400 are now on the flat $240 basis, and we summed up our view of the matter by suggesting that as to telephony —like many other things—"everywhere in the world the cost of operation increases with the size of the city." So far as we can make out, this is the full and total extent of our "disingenuousness," viz., the showing up of the ignorance of the *Times* as to conditions in its own city, and its readiness to accept as true the oft-refuted statements as to telephony abroad.

But this is perhaps all irrelevant to the real issue, which the *Times* raises as follows:

It may be clear to the electrical expert why a telephone service should cost more per unit in a district closely connected and densely populated than in one less compact and containing fewer people, but the average layman will find it difficult to understand why this should be so, or to believe that it is so. In any other business the conditions are exactly the reverse of those claimed to exist in the telephone business. Gas and electric lighting may be taken as illustrations. It might very well be true that at a scale of charges so high as to discourage the use of the telephone the relatively high cost of city installations and operation would appear to show that the cost of operation increases with the size of the city, but probably that is not what our technical contemporary means. If, however, it means anything else, we shall be compelled to insist that we think it mistaken.

It is certainly very clear to us why telephony in a city costs more per unit to operate than it does in a small town or village. It is one of the facts that there is no escape from, and we deny flatly the allegation of the *Times* that "in any other business the conditions are exactly the reverse." The fact that in telephony in New York the greater volume of business has been attended with lowering rates, shows that the use of the telephone here is not "disc ed." Indeed, we believe the ratio of calls per subscriber in New York is one of the highest in the world; but it is equally true that because of the higher cost of operation, the local company gets less out of each call

than it would if operating in a town like Stockholm, or, say, Chattanooga, or Sag Harbor. Many things making for the higher cost of operation could be mentioned; it will suffice to name rent, wages, underground wires, insurance, depreciation. If there is any other telephone system that comes near that of New York in the costliness of these items, we do not know it, and the nearness of the approximation carries with it a proportionately higher telephone charge, for equivalent service. Besides, the great, overhanging problem in telephony is how to maintain a margin of profit as the business grows. To keep ready the plant that will enable 5000 subscribers to talk to each other is to us and others obviously much less expensive than to provide and maintain the plant that will give 50,000 subscribers the same swift intercommunication. In other words, the "stand-by" charges grow out of all proportion to the possible return on any one "call," and in this respect telephony is by no means alone. To go no further than the field of electricity, it is a notorious fact that the cost of telegraphic operation has steadily gone up, with a lessening profit on a larger volume of business; and the problem in electric lighting to-day in great cities is to so adjust the tariff that the increasing cost of the "stand-by" charge for plant and operation shall be borne fairly by the consumers. It might be urged that telephone exchanges should therefore be kept down to a certain size, but that evades the point, namely, that the value and efficiency of the system consists, not in being limited, but in being able to reach every one of the other 50,000, if and when desired. The larger the city the greater the number of possible subscribers, all to be put in touch; and there seems no way of getting around the difficulty. The man who will devise improved scientific checks to telephonic conversation, while adding to the volume of business and maintaining an ordinary rate of return on the investment, will be the telephone manager of the future; but even he cannot avoid providing the plant that must be there when his fifty or one hundred thousand subscribers do want to talk. He will be more than happy if some such device as the "telegraphone" comes in to serve as a storage battery and take care of the "peak of the load."

A reference is made by the *New York Times* to the new system which the English Post Office has been laying down in London. When that system has shown what it can do, it will be time to cite it. The *Times* says: "It may very well be that the officers of the London Post Office do not know what they are at, and that they are about to bankrupt the department by undertaking the impossible; but we should prefer to learn this from authoritative British sources." We are glad once more to furnish the *Times* with the "authoritative" official information it craves. The British Postmaster-General has just confessed in his annual report to a deficit of $3,260,500 for his telegraph and telephone department for 1900, and he has been doing this steadily for years and years past. He is not merely getting ready "to bankrupt his department," but has done it ten times over, with increasing prospect of redoubling his disaster by reckless plunges into "undertaking the impossible" in telephony.

THE HUMAN ELEMENT AS A FACTOR IN ENGINEERING.

Elsewhere in this issue Mr. Joseph D. Baker writes in an interesting manner on the subject of public co-operation in perfecting telephone service, and clearly shows how vastly such service might be improved were the public to realize the important factor it is in its economical conduct, and then act accordingly. It is pointed out that the most consummate skill may be applied in working out all the technical details of an undertaking and then the result aimed at found to be unattainable through the public failing to apreciate that it is a factor, perhaps even more important than those that entered in the calculation of the complex engineering problems involved. In reply, it might be said that every problem should be solved with respect to every factor entering, and that a solution which neglects the human one cannot be said to show, in the broader sense, consummate skill, however much it may deserve that commendation with respect to its purely technical features. However this may be, the fact remains that the public, and particularly the American public, is apt to play its part to a reasonable point of efficiency where it enters as a factor in the attainment of an economical service, as is shown in New York by contrast between the movement of elevated trains at ordinary times, and on exceptional days when a large proportion of the passengers are from out-of-town.

In telephony, however, the matter of inducing the public to play up to the part which has been assigned to it in the efficiency problem is by no means an easy one. In the first place, the telephone user controls the situation, not having before him the fear of being eliminated by the exchange on the score of his inefficiency. Again, he is apt to regard his telephone a purely personal convenience—or more often inconvenience—and is not likely to consider that he should "step lively" to accelerate the exchange service. Moreover, when he goes to the telephone his mind is usually concentrated on the subject of communication, and the slightest delay or interruption is likely to give rise to irritation and to unjust suspicions as to the capacity of telephone operators and the efficiency of exchange management in general. Having thus no means to coerce the telephone subscriber, the only recourse is to his good will. Every civilized man has some inward sense of obligation toward others, and with advantage of this intelligently taken, much may be accomplished. In case of long-distance service, for example, to which Mr. Baker refers, if he knew the various operative steps between his call and the commencement of communication he would be less likely to lose his temper at the delay incident to long-distance connections, and would be aware that the occasional words and syllables from one or more operators which he hears while impatiently waiting, are not impertinences intended to prey still further on his nerves. In other words, we believe it would be to the interest of every telephone exchange to supply subscribers with a clear and tersely-written account of the various steps in exchange connection, and explain the reasons for delays that may reasonably be expected. This information could be made to convey indirectly directions conducive to economical exchange operation, which, if offered on that score alone, would receive little or no attention. In brief, the matter of securing the highest efficiency so far as telephone users are concerned, resolves itself, in the absence of any coercive remedy, in an appeal to the intelligence and good nature of subscribers, to which they will respond where they might consider as an impertinence a request to co-operate with the exchange on the score of the greater commercial advantage which will thereby inure to the latter.

THE NERNST LAMP.

Mr. Wurts' paper on the Nernst lamp recently read before the A. I. E. E. Convention, gives the first official engineering information available concerning the progress of that light source in this country. A perusal of that paper will satisfy all those who are familiar with the experimental difficulties of preparing a device of this kind for commercial use, of the very large amount of labor that must have been expended upon it in order to effect the results already indicated.

If the Nernst lamp, as at present prepared, be compared with the incandescent lamp for purposes to which incandescent lighting is applied, the comparison can only be very unfavorable to the new apparatus. An incandescent lamp is simplicity itself in so far as its con-

nections with the mains are concerned, whereas the Nernst lamp requires an auxiliary heater, a ballast of hot iron wire, and a heater cut-out magnet. The wiring diagram of a six-glower lamp resembles the wiring diagram of a switchboard in complexity. Moreover, an incandescent lamp does not require to be touched until it requires to be renewed; whereas the Nernst lamp requires to be cleaned at regular intervals during its life. The incandescent lamp is used in sizes down to 8 candle-power, whereas the smallest Nernst lamp yet attempted in this country is of 50 candle-power. In this comparison with the incandescent lamp, the only offsets in favor of the Nernst lamp are its color, and its efficiency, which is clearly considerably in excess of incandescent-lamp efficiency. Finally, the expected cost price of the Nernst lamp per candle-power is relatively much higher than that of the incandescent lamp.

If, however, the Nernst lamp is compared with the arc lamp, for purposes to which the arc lamp is ordinarily applied, the comparison is much more favorable to the new device. Its complexity is not much greater than that of an arc lamp. It is likelier to be steadier in action than an arc lamp, and to require considerably less attention during operation, since there are no carbons to be renewed. It is capable of being operated directly from 220-volt mains without the insertion of several lamps in series, and is capable of being adapted to trolley car lighting. It would seem that there may be an extensive field for the Nernst lamp in the direction of the service in which arc lamps are at present retained. The efficiency of the new lamp seems to approach that of the arc lamp. The expected cost price of the new lamp is not far from that of an arc lamp, and the color of the light is also similar. For arc lamp service the delay of the few seconds required aftern turning on the current, in order to light the Nernst lamp, is not usually a serious matter, whereas, in incandescent light service, such a delay might frequently give rise to tersely pronounced objections. A great advantage of the new lamp in comparison with the arc lamp is that it may be operated on low-frequency circuits. Taking the length of the glowing Nernst filament as 2.5 centimeters, the diameter 0.63 millimeter, and the power as 86 watts, the surface activity of the Nernst filament is approximately 172 watts per square centimeter, as compared with some 70 watts per square centimeter in the incandescent lamp and 3000 watts, estimated, per square centimeter in the arc lamp.

CERTAIN PHASES OF RESONANCE.

Apropos of the very able paper on this subject by Mr. Steinmetz, we are moved to suggest that it would be highly desirable to collect and collate data on the examples of resonance found on practical alternating circuits. As a study of the theory and calculation of the phenomenon, the president of the Institute's paper left little to be desired, but there is still much work to be done. Given the constants of the system, and the computation of the conditions of resonance becomes a comparatively straightforward problem; but the constants are extremely difficult to determine in any practical case. Inductance and capacity in power transmission systems appear not as definitely located in series or parallel relation, but very irregularly distributed, with all sorts of damping devices between them, and in a mutual relation by no means constant. The line usually has much less inductance and often less capacity than the various translating devices. Instead, therefore, of finding the system with either localized or distributed capacity and inductance, it presents an irregular mixture of both conditions, and, in fact, must be treated as if it were broken up into a group of circuits having each both localized and distributed capacity and inductance in amounts often both variable and unknown, and having constantly shifting material relations. It is this breaking up into irregular electro-dynamical segments which presumably gives rise to the localized resonance that is sometimes unpleasantly in evidence, breaking down insulation near a particular point many times in succession. Thorough study is needed of the inductance and capacity of apparatus and cables in various normal and abnormal connections, and of the effect of grounds and open circuits upon the system at various stages of load. The ideal conditions of uniform distribution or definite location are changed in practice to variable factors on an irregularly loaded network, and with the data now available computation is almost hopeless.

THE SYNCHRONOUS AND INDUCTION MOTOR.

The paper read by Mr. C. F. Scott before the recent A. I. E. E. Convention reopens the old discussion which has so long been maintained between the advocates of the synchronous motor and of the induction motor, respectively. Mr. Scott evidently believes in induction motors, and seems inclined to disparage the use of synchronous motors. The salient facts on both sides of the question are, however, capable of being readily condensed. Where a motor must start with full-load torque there is no choice, and an induction motor must be used. Where a motor starts light and receives its full load after having come up to full speed, then either the synchronous or the asynchronous motor may be used. The synchronous motor—which, however, postulates skilful attendance—has the advantage that its power factor is adjustable, and can be made to suit the requirements of a transmission system, whereas the induction motor has a definite and a lower power factor, that is constant for a given load. Small motors usually have to be induction motors, and so must all motors that start under full load, but otherwise it seems advisable to employ a mixed equipment when possible in order to obtain the best output from the generators, and the best operation on the system.

In the discussion which followed the paper many different opinions were elicited, showing that the preference in any case depended upon the local conditions. It would seem that in time, with development and that reduction of cost which follows development, the induction motor may take the entire ascendency. At all speeds below synchronism, the induction motor is essentially a motor, and does not act as a generator, whereas at any and all speeds the synchronous motor never forgets that it is essentially a generator. At the present time, however, and at present costs, there does not seem to be any marked advantage of one motor over the other for light starting loads. The simplicity of the one is offset by the better power factor of the other.

As regards starting current on light load, the two motors are not dissimilar. Synchronous motors commonly start with reactances in their armature circuits sufficient to keep the starting current down to a value 50 per cent above full-load current. Induction motors starting under light load, and employing short-circuited secondaries, are commonly started by reactances similarly interposed in the main circuit for the purpose of keeping the starting current down to a little more than full-load current. Either motor will pull out if overloaded beyond a certain limit. In that event, the only difference is that whereas the induction motor can recover, the synchronous motor will have to be started afresh. In all cases, the comparison is assumed to be made between induction motors and polyphase synchronous motors as distinguished from the single-phase synchronous motors of the days prior to polyphase alternating-current development. In any comparison, including the single-phase synchronous motor, the disadvantages of this machine, except in small sizes or in special cases, are very conspicuous, particularly from being quite incapable of starting from rest unaided.

The Edison Convention at Buffalo.

Mr. Wilson S. Howell, secretary, states that in accordance with previous announcements, the seventeenth annual meeting, twenty-second convention, of the Association of Edison Illuminating Companies, will be held at the New York State Building, Pan-American Exposition Grounds, Buffalo, N. Y., Sept. 10, 11 and 12, inclusive. It is expected that the following papers will be presented:

"Modern Electric Light Accounting," by Mr. A. S. Knight, Edison Electric Company, Boston; "Competition with Isolated Plants," by Mr. John F. Gilchrist, Chicago Edison Company; "On the Selection of a Cable for a Given Service," by Mr. Wallace Clark, Schenectady; "The Evolution of Exposition Lighting," by Mr. Luther Stieringer, New York; "Some Notes on a Short European Visit," by Mr. Arthur Williams, New York Edison Company; "Timely Lamp Topics," by Mr. F. W. Willcox, Harrison, N. J.; "Spherical candle-power of Incandescent Lamps," by Clayton H. Sharp, lamp-testing bureau; "Progress in Electric Switch Design," by Caryl D. Haskins, Schenectady. A paper is also expected from Mr. Chas. P. Steinmetz, Schenectady, N. Y. Interesting reports will be presented from standing committees on meters, incandescent lamps, automobiles, etc., etc. The official headquarters of the association will be Niagara Hotel, Buffalo, N. Y. The association will be the guest of its local member, the Buffalo General Electric Company.

Long Distance Trolley for Chicago.

Arrangements are being made for the opening of the new electric trolley line between Joliet and Chicago, built by the American Railways Company. The line is 40 miles long, the road-bed is rock-ballasted and laid with 70-lb. steel rails, double track. The running schedule between Joliet and Chicago is 1 hour and 30 minutes, and the fare will be 40 cents in each direction. As soon as the road-bed is settled, faster time will be made. The motors on the cars will be geared to a speed of 40 miles an hour. The cars will be 48 ft. long, and in addition to carrying passengers there will be compartments for carrying baggage and express and package freight. As soon as practicable the company expects to build a spur from the main line near Summit to Riverdale, where connection will be had with the Suburban Railway, which now connects with the Lake Street and Metropolitan Elevated roads. It is hoped to eventually get the running time between Joliet and the City Hall in Chicago down to an hour and a half. Cars are now being operated on the line between Joliet and Lamont. Officers of Rock Island, Alton & Santa Fe say they fear little loss of business by the coming competition of the trolley. It is believed that the trolley will capture a large share of the express and package freight business. The lowest fare by the railroads between the two points is now $1.06 for a one-way ticket, 56 cents on 25-ride tickets, and about 45 cents on monthly tickets.

Submarine Boats.

It is reported that extrordinary efforts are to be made to obtain the passage of a joint resolution in the next Congress authorizing the construction of 50 boats of the Holland type. The Navy Department Board on Construction unanimously advises that no further increase be made along this line, pending the settlement, by exhaustive tests, of the relative efficiency of the submarine boat. The friends of this type of craft argue that, inasmuch as they can be built in three months, whereas it takes five years from the inception of its design to completion to build a battleship, the naval increase of this country for the next seven years should be confined, nearly exclusively, to the submarine type. It is the purpose of the Navy Department to appoint a board of unbiassed officers this winter, and to test conjointly the "Holland" and the "Lake" boats. The naval committees of both Houses of Congress will be invited to be present at the tests, and it is hoped that the general and individual questions relating to submarine boats will be finally settled. A cable dispatch from London of Aug. 30 says: The *Express* states that France and Russia, working in secret, will have built and ready for sea in November 92 sub-marine boats. All the boats will be powerful and of the newest type. England is only constructing five experimental submarine boats. In view of the influential backing of the Holland Company it is probable the naval opposition will, as it has in the past, prove futile.

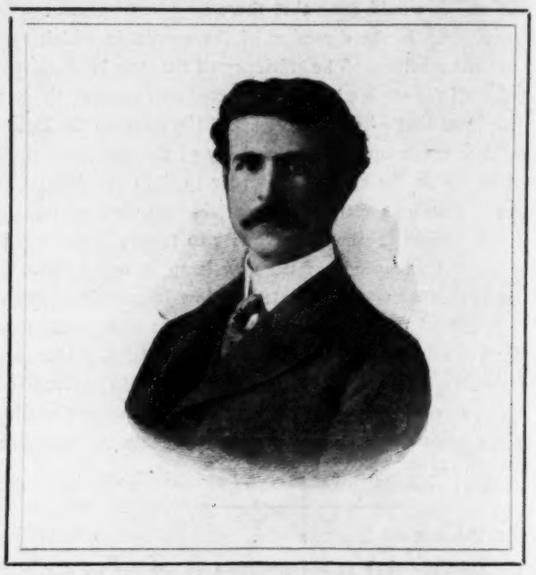
Electrical Engineers of the Day—X.

A. S. CLIFT.

While it is true that the ranks of electrical engineers in this country receive constant accessions from Europe, many of the newcomers making distinguished positions for themselves, it is equally true that of late years American electrical engineers have been welcomed to Europe and are now to be found there in every country in which the electrical industries are progressing.

One of the latest of these American electrical engineers to go abroad is Mr. A. S. Clift, who has become the chief mechanical engineer for Siemens Brothers & Co., Limited, of Woolwich, England, and who is now actively engaged on work for that celebrated concern, which has always shown conspicuous skill in the selection of its staff.

Mr. Clift is the son of the late Captain E. W. Clift, U. S. A., who conducted a large number of important surveys and whose name was associated with other responsible engineering work in the army. Inheriting marked talent from this source, Mr. Clift from the first devoted his attention to engineering studies, and in 1895 he graduated from the Mechanical Engineering Department of Lehigh University, where his record was particularly creditable in mathematics. Leaving college, he went into the General Electric shops at Schenectady, and shortly after was transferred to the drafting room. The work that he did there and in the engineering department in the calculation and design of generators and motors, together with the opportunity enjoyed for studying the construction of a large range of apparatus,



constituted a valuable experience and formed an excellent basis for later work. He was next offered a position with the Crocker-Wheeler Company, and in the fall of 1897 was placed in charge of its mechanical designing. In that capacity he assisted in developing various forms of direct-current apparatus, including complete lines of motors and generators of the several types built by that company.

In all such work Mr. Clift has made a close study of the mechanical design of electrical apparatus, believing that weakness was more often developed there than in the merely electrical features. As a result, he originated several new details of construction, and has met with some measure of success in producing machines combining low shop cost with the elements of good, substantial and symmetrical design. This is more particularly true of applications of electric power where in order to meet the specified conditions, distinctly novel constructions and expedients had to be resorted to.

During the past year Mr. Clift had become very much interested in the development of telpherage, and in conjunction with Mr. H. McL. Harding, he may be credited with the practical development which that new and promising art has made. The first modern telpherage line of any length was erected at the Crocker-Wheeler shops at Ampere, N. J., and was, therefore, under the constant observation of Mr. Clift, so that every experimental advance was tested by him before its adoption as part of the system.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds up to 125 Miles an Hour.

BY WALTER REICHEL.
(Chief Engineer Siemens & Halske Company.)

WHEN the author of this paper about a year ago described in a German technical journal a trial road built by Siemens & Halske, giving details of the circuits and the locomotive, which was designed for long-distance service, and employing 10,000 volts, he little thought that so soon afterwards he would have an opportunity to record another step in advance in the polyphase electric railway field. It is nevertheless a fact that the great work about to be described, and which was inaugurated and financially backed by a number of enterprising banking houses, technical and electro-technical firms, and sanctioned by influential officials, will soon be completed and put into operation.

As early as May of last year the "Studiengesellschaft" (Society for Research), inspected the Siemens trial road at Grosslichterfelde, plans were drawn up for a high-speed railway, patterned after this road, and it was concluded to build two experimental cars, which were to run over the tracks of the Royal military road between

FIG. I.—MAP OF ROUTE.

Marienfelde and Zossen. The mechanical work on the two cars was done by Van der Zypen & Charlier, of Cologne, and the electrical equipment of one of the cars was furnished by Siemens & Halske, and that of the other by the Allgemeine Elektricitats Gesellschaft. The Siemens & Halske Company also took the contract of installing the electric line construction while the A. E. G. generated the current in its power station at Oberschonweide and laid the feeders from that place to Marienfelde. The following article describes this interesting electric railway installation:

THE PROBLEM.

The problem may be sub-divided as follows:

1. The single track military road near Berlin, shown in Fig. 1, was selected. It is about 14¼ miles in length between Marienfelde and Zossen. The smallest radius of curvature is 3280 ft. (1000 metres), and there are grades as steep as 3 per cent (1:184). The gauge is normal. The rails are laid on wooden ties.

2. The car to seat 50 persons. It is to be no larger in width and height than the standard Prussian State railway car.

3. Two normal gauge trucks, with three axles each, to be employed, and these must be able to support a maximum load of 16 tons per axle inclusive of the passenger load.

4. The current supplied is to be of the three-phase type, 10,000 volts pressure, and having a frequency from 45 to 50 p. p. s.

5. The control and regulation of the motors (the current collector and switching in of all apparatus), to be so arranged that the operations can be performed independently at each end of the car.

6. The speed is to be varied between 125 and 135 miles per hour (200 and 220 km.). The electrical apparatus to be so designed that a round trip on a stretch measuring 155 miles (250 km.) can be made without unduly overheating them.

7. The rates of acceleration and of braking are to be so chosen that between the period of acceleration and the beginning of the period of braking there shall be sufficient time left for the careful observation of the power required for full speed. The length of this time for a distance of, say, 6½ miles (10 km.), is 3 minutes. There are to be two independent brakes, a mechanical as well as an electrical one.

8. The necessary measuring and controlling apparatus are to be furnished.

9. The car is to be electrically lighted, for which purpose a storage battery may be used.

Before the general design and method of construction of the car, etc., and the various details can be discussed, it is necessary to first determine the power requirements, so far as existing knowledge and means at hand will permit. Only after this is done can a general idea as to the capacity and size of the electrical equipment of the car be obtained, upon which the working out of further details largely depends.

POWER REQUIREMENTS.

According to the experience gathered in the railway field it is to be assumed that the air resistance which a vehicle has to overcome when starting and when moving at full speed, is the principal resistance to its motion, and it should therefore be carefully determined. The formulæ used heretofore give values which are too high when employed for speeds as great as 125 miles (200 km.) per hour. Thus, for example, the formula of Grove & Clark:

$$W_0 = 2.25 + 0.001\,V^2,$$

in which V is the speed in km. per hour, gives as the resistance in kg. per ton of car weight:

$$W_0 = 2.25 + 0.001\,(200)^2 = 42.25 \text{ kg. (93 lbs.)},$$

which measured at the rim of the wheel, under normal conditions, is equal to

$$N = \frac{96 \times 42.25 \times 55}{75} = 3000 \text{ H. P.}$$

The above formula, however, is only correct for speeds up to 62 miles (100 km.) per hour, is applicable only to whole trains, and gives the resistance in kilogrammes per ton of weight of train; while in this instance we are dealing with a single car, and besides it would be more correct to separate the air resistance from the frictional resistance. The latter consists of the sliding and rolling friction and the resistance caused by the jars at the rail joints and the bending of the rails. This is usually assumed as 2.5 kg. (5.5 lbs.) per ton, and may be calculated approximately. We will, however, not enter into this, as it would lead us too far, and for safety shall assume 4.5 kg. (10 lbs.) per ton. Then the draw-bar pull at the rim of the wheel, in order to overcome this resistance, must be:

$$P_r = G\,W_r = 96 \times 4.5 = 450 \text{ kg. (appr.) } 1000 \text{ lbs.}$$

If it be desired to determine the air resistance against the head end of the car, which is assumed to be round and have an area of 10 square meters (12 square yards), using the well-known formulæ (Hutte, Part I., Section F, Wind Pressure and Air Resistance), then the values obtained are again too high. (See Curve I., Fig. 5.)

There can be no doubt as to the correctness of the formula. The constant used, however, might be smaller than 1.85 for a long body. It might therefore be possible to construct a device by which this

constant might be decreased. This might be done by tapering the surfaces, which would undoubtedly have the effect of decreasing the value of the constant. In order to investigate the effect of these tapered (inclined) surfaces, experiments were made, which may be briefly described as follows:

As no claim is made as to absolute scientific accuracy, the only desire being to determine the approximate extent of the air pressure and the influence of specially formed head ends, it was deemed expedient to employ very simple means and to approximate as closely as possible the proportions met with on railway cars.

Naturally, experiments could only be made with revolving wings, as in no other way could a speed of 55 m. (180 ft.) per second be obtained. It was to be expected that the values thus obtained, on account of the centrifugal effect and the doing away with the friction caused by the wind at the sides, would be a trifle too low. This, however, may be corrected for by a corresponding addition to the value of the air resistance against the front surface.

A large motor, from which 200 horse-power could be taken for a short period, was mounted on a solid base, composed of rails, with its shaft in a vertical direction, and was anchored in all directions, as shown in Fig. 2.

At the top of the motor shaft a wheel of an ordinary street car was mounted, and fastened to this by means of heavy pieces of sheet metal was a horizontal plank 85 mm. (3⅜ inches) thick, 500 mm. (20 inches) wide, and 6350 mm. (21 ft.) long, which carried the experimental surfaces or bodies. The field coils of the motor were separately excited, so that the motor would run as a shunt motor

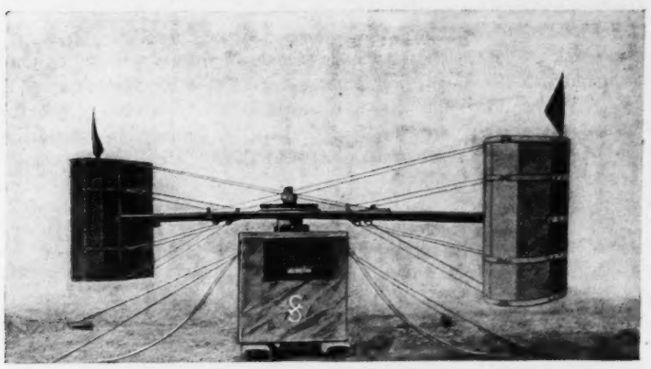


FIG. 2.—AIR RESISTANCE EXPERIMENTS.

having a constant speed at a definite pressure. The armature was excited by a special machine in such a manner that its speed, excitation and pressure could be varied between definite limits. In this way the speed of the motor could be varied at will. The device was started at the beginning of the tests by means of a water rheostat and disconnected by the same means at the close.

For the first experiments plane surfaces made of smooth boards (without having any appreciable thickness in the direction of rotation) were used. These boards were securely fastened to the plank.

These trials showed that the method was a correct one, and would in time give satisfactory results. They also showed that plane surfaces without any inclinations give too high values and that the tapering was very essential. (Fig. 5, Curves II. and III.)

For the experiments which followed and which were to be final, the revolving body had more of a parabolic shape, as shown in Fig. 3, and the experience gained in the preliminary trials was made use of in these final ones. For instance, in the final tests the speed was recorded electrically by means of a double Morse register, which at the same time made dots on the strip of paper at regular time intervals. The make and break contacts for recording the speed were attached to the shaft of the motor, which is shown in Fig. 4. Current and pressure were measured in the usual manner, so as to obtain the power consumption. The latter was also measured for the plank revolving without the parabolic bodies attached, and the heating effect was also measured.

These trials, after some mishaps had been overcome, gave some astonishingly good and accurate results, shown in Fig. 5, Curve VII. The pressure against the parabolic surfaces was only about one-third of that against the flat ones. It must be kept in mind, however, that in the final tests solid, box-like bodies were used, while in the preliminary tests with flat surfaces the air could rush together immediately behind them, and thus have a more pronounced effect.

It should also be mentioned that in order to check the speed of the motor with eye and ear, a carefully woven cloth was attached to the extreme outer surface of the revolving bodies which could be easily seen and the waving of which would be plainly audible. This cloth was entirely torn into shreds after a half hour's usage. These small shreds had deposited themselves onto the roughened surfaces of the other body, and thus indicated the current of the air. The latter streams from a mean pressure line towards the edges of the most forward surface.

Curve VII., Fig. 5, shows a wind pressure of 90 kg. per square inch

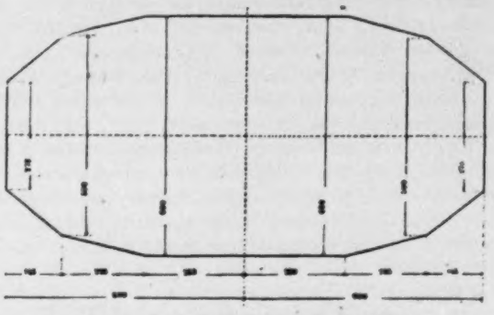


FIG. 3.—AIR RESISTANCE EXPERIMENTS.

(about 19 lbs. per square foot), at a speed of 200 km. (125 miles) per hour. This may be too low, as bodies moving in a straight line may give higher values than revolving bodies. Furthermore, the surface is greater and therefore the pressure coefficient, and, finally, the friction along the sides of a long, moving body must be taken into consideration, all of which could not be determined. It is, however, partially eliminated by not making the roof of the car like the top of the revolving bodies, but by slanting the roof downward in front and rear, which certainly decreases the resistance. The head end of the car is furthermore assumed to have an area of 10 square inches (12 square yards).

The draw-bar pull necessary, therefore, to overcome the wind pressure is

$$P_w = F_p = 10 \times 90 = 900 \text{ kg. (1980 lbs.)}$$

At a speed of 55 m. (180 ft.) per second the total power of the car, measured at he rim of the wheel, expressed in horse-power, is

$$N = (P_w + P_r)\frac{V}{75} = (900 + 450)\frac{55}{75} = 950$$

or, in round numbers, equals 1000 horse-power.

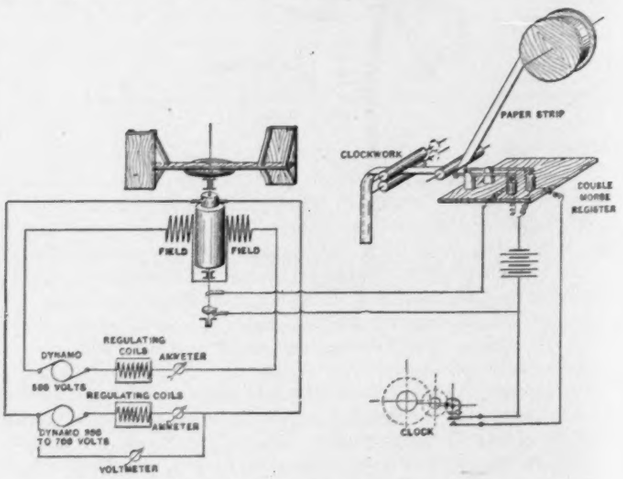


FIG. 4.—APPARATUS FOR DETERMINATION OF AIR RESISTANCE.

Now, that the power capacity of the car has been determined, we will describe the design and equipment of the same.

GENERAL DESIGN OF THE CAR.

Two conditions were imposed upon the builders of the car. First, the capacity had to be 1000 horse-power; second, the maximum weight was to be 96 tons. No restrictions were placed on the elec-

trical equipment, nor the length of time the apparatus was to be kept in service. There is very little data at hand which would assist the designers in determining the proportions of the various electrical devices to meet the desired requirements, but in view of the magnitude of the latter it would appear that the equipment should be as heavy as is permissable within the limits of the prescribed weight of the car, in order to meet the requirements with safety.

In this manner the problem was approached, and the final execution of the plans was the result of numerous designs and calculations (especially of weights), the mechanical and electrical devices being altered in size and capacity and shifted about as was deemed most expedient.

The following table shows the distribution of the weights of the various apparatus:

MECHANICAL PORTION.

	Kg.	Lbs.
Car body, iron frame and metal sub-structure, wood, glass, seats, hand-brake with appurtenances, air brake with pipes and reservoir, floor and roof covering.....	20,700	45,540
Trucks complete, including wheel base, auxiliary air reservoirs and brake cylinder and brake shoes	27,300	60,060
Total	48,000	105,600

ELECTRICAL PORTION.

	Kg.	Lbs.
Motors without axles and wheels, but including support	16,300	35,860
Complete rheostat controller	5,100	11,220
Controller with pneumatic attachment, electrical circuits, safety devices, fuse boxes, switches and levers for motormen.....	4,750	10,450
Large transformers and their support.....	12,300	27,060
Air pumps and supports	1,000	2,200
Small transformers for the same	650	1,430
Current collector with attachments	1,300	2,860
Lighting devices, including battery	500	1,100
	41,900	92,180
Adding for safety	600	1,320
Total	42,500	93,500

PASSENGERS.

	Kg.	Lbs.
Fifty passengers, including motorman and conductor at 80 kg. (176 lbs.).....	4,000	8,800
Total	4,000	8,800

Adding these we get:

$$48{,}000 + 42{,}500 + 4000 = 94{,}500 \text{ kg.} = 207{,}900 \text{ lbs.}$$

which is equal to 94.5 metric tons.

In apportioning the various weights the electrical equipment in the car body was made as light as practicable, and it was so distributed that the car body support might be made as light as possible. This will be evident from the following detailed drawing of the car construction and equipment, shown in Fig. 6.

THE MECHANICAL EQUIPMENT OF THE CAR.

The requirements of the car body are that it shall be of such a size as to accommodate 50 passengers, who are to be provided with cross seats in a center compartment, called salon, and two rooms adjoining the salon. The central room is 7.3 metres (24 ft.) in length, contains 18 seats, while the adjoining compartments are 4 metres (13.12 ft) long and each has a seating capacity of 12. Adjoining these sections is the ante-room or platform on which there are three seats 1.75 metres (5.74 ft) in length. From this platform passengers enter and leave the car. Finally, there are the two platforms (one at each end) for the motorman, which are 1.6 metres (5.24 ft.) in length. The car has therefore 48 seats and is 22 meters (24 yards) in length.

The body is carried on longitudinal girders which are joined together on top and bottom, thus being light in weight, but capable of bearing a heavy load. The plates joining the girders are composed of U and flat iron, and are connected by heavy sheets of iron reaching from the lower end of the windows to the lower edge of the car body.

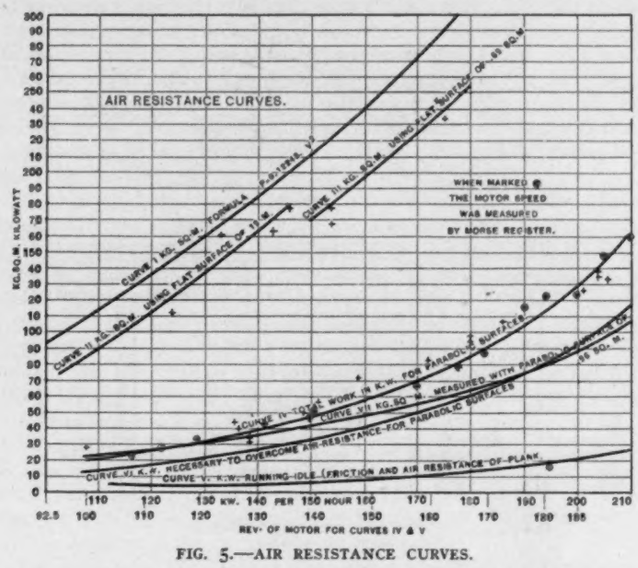


FIG. 5.—AIR RESISTANCE CURVES.

Besides the above, the frame is braced transversely and longitudinally in the usual manner, the arrangement of which depends largely upon the location of the various electrical apparatus. At the front and rear end couplers and bumpers prescribed by the Prussian Railroad Department are attached.

The interior arrangement of the several sections and the entire car body is the same as that of a third-class car of the Prussian State roads. The seats are made of wood and are fixed to iron supports. The car greatly resembles in outward appearance the ordinary train car, except that the front and rear ends are of a special parabolic shape so as to reduce the resistance to the air. The roof also slopes down in front and back. The entire body can be mounted into the truck frame without the use of springs, by means of a projecting pin. The truck frame, however, is separated from the journal boxes by a double set of springs. The structural iron truck frames primarily rest upon spiral springs which are adjustable by means of a bolt. From these the load is transferred to long, flat springs which rest on

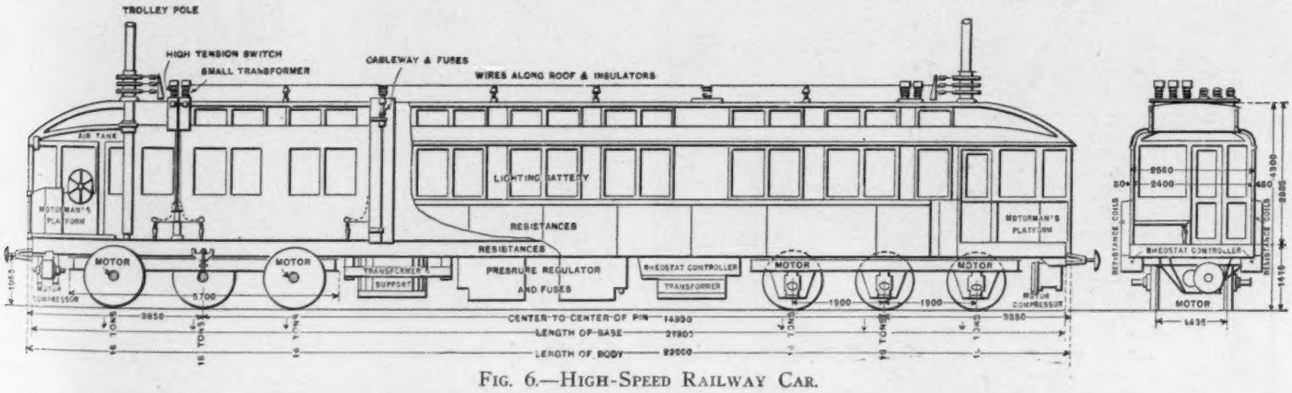


FIG. 6.—HIGH-SPEED RAILWAY CAR.

the journal boxes. The middle one of the three axles is not used for the mounting of the motor, because the space above it has to remain free for the supporting frame for the pin in the car body and the braking apparatus. In order therefore to have an equal load on all the axles, the springs for the running axles must be stronger than those for the motor axles. All of this is clearly shown in Fig. 7.

The braking is accomplished by an automatic Westinghouse brake

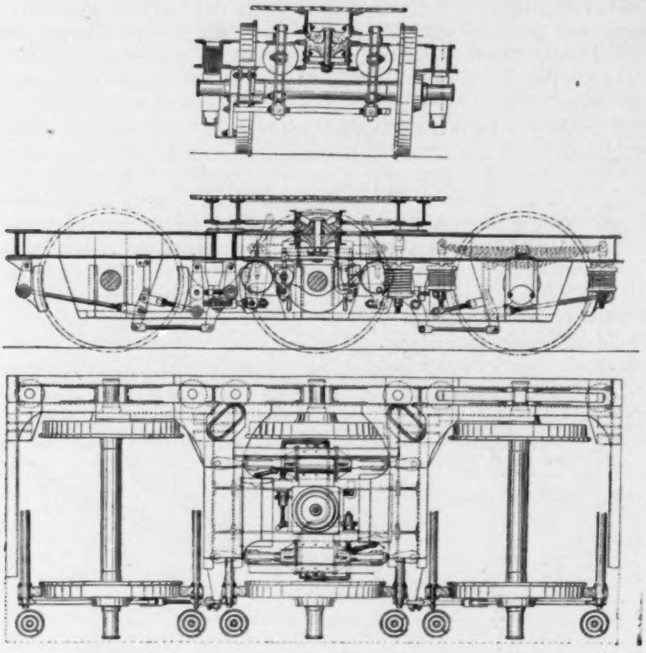


FIG. 7.—TRUCK FOR HIGH-SPEED RAILWAY CAR.

and all wheels are braked on the two sides, so that 100 per cent of the weight of the car is braked. For this purpose two 10-inch brake cylinders are built into each of the trucks. In this way each truck is a distinct operative vehicle by itself, and each has in addition two auxiliary air chambers. The various brake rods of the Westinghouse brake may furthermore be acted upon by a handbrake, by means of which the motorman, stationed at either end of the car, can brake about 80 per cent of the total weight of the car. The outside diameter of the wheels is 1250 mm. (48.21 inches).

All the above conditions were incorporated into the designs of Van der Zypen & Charlier, who built the cars. A cross-section of the car body is shown in Fig. 8, while the truck is shown in three views in Fig. 7.

FIG. 8.—CROSS SECTION OF CAR BODY.

ELECTRICAL EQUIPMENT OF THE CAR.

The following conditions have to be complied with in the design of the electrical equipment. In the first place, the passengers and employes must be adequately protected against the danger of high tension currents. This is only possible when all apparatus and wires are situated under the car floor or under the roof, which are connected to the earth by means of sheet metal plates. None of the apparatus is to be made directly operative by the motorman's hand, but by means of a special power device. This also simplifies the operations and does not tax the strength of the motorman. Compressed air seems well adapted for this purpose, as it has to be carried on the car for the operation of the brakes. The air reservoirs for power and brake purposes, however, must be separate.

The equipment must be so arranged that all parts can be easily inspected, be easily attached and removed, and in case any device becomes inoperative, another part of the equipment can supply the deficiency. The load must furthermore not all be concentrated at one point, but must be evenly distributed, the effect of which will be that the heat which is generated will be more easily dissipated.

Compliance with these conditions made it necessary from the start to divide the electrical equipment into two distinct units, each one containing two motors, with two rheostats, two main switches, two fuses, a large transformer, with delta and star switches in the secondary, and primary high-tension switches as well as high-tension protective device; an air pump and small transformer with fuses, a current collector (trolley), an air reservoir, a motorman equipment with compressed air switches and measuring instruments. How these devices are connected together is clearly shown in the diagrams (Figs. 9 and 10).

Although the diameters of the wheels have been made 125 cm. (48.21 inches), the number of revolutions made by the wheels is still so great that it has been deemed advisable to mount the motors directly on the axles. Each truck is supplied with two motors, the

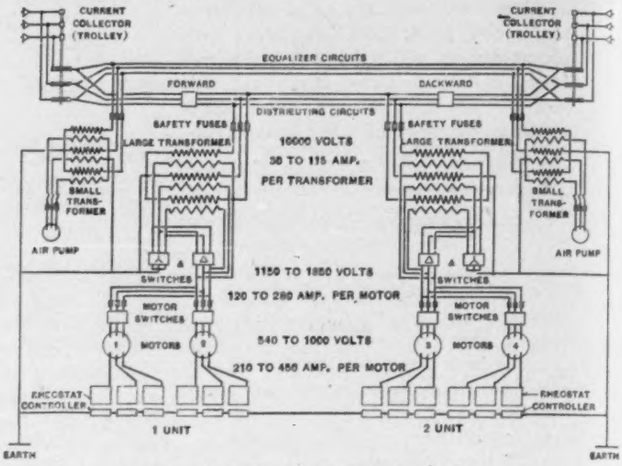


FIG. 9.—DIAGRAM OF CONNECTIONS.

entire car therefore with four, so that each motor only has to furnish one-fourth of the entire 1000 horse-power.

In order not to consume too much time at starting, it has been calculated that the motors must be capable of furnishing 3000 horse-power. The increased capacity is usually obtained by loading the motors more heavily. In case one equipment is disabled, however, the pressure in the primary circuit of the motors will be raised. The pressure has to be so chosen that the current strength will not be too great, so that the contact surfaces of the motor switching devices will not be too large. The primary pressure for full speed has therefore been chosen as 1150 volts, and for starting as 1850 volts. The motor speeds are regulated by means of resistances, which are

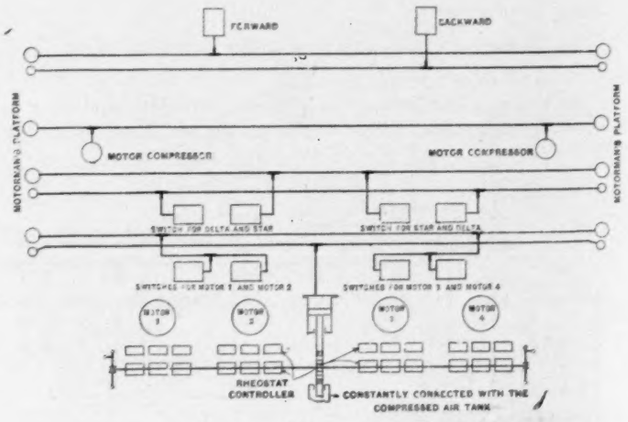


FIG. 10.—SYSTEM OF PIPES LEADING TO SWITCHES AND CONTROLLERS.

inserted in the secondary circuit of the motors, and are cut out successively until the induced winding is entirely short circuited. The secondary voltage at a standstill, i. e., at the point of starting, is about 650 volts.

So as to avoid a possible breakdown, metallic resistances are employed. On account of the excessive room which they occupy and

in order to insure their cooling off, the resistances are inclosed in flat cases which are placed along the two side walls of the car between the two doors.

In order to make the connections between the resistance coils and their controllers as short and simple as possible, the controller cylinders are distributed in a similar manner to the coils themselves. For this purpose the space below the resistance boxes between the two trucks was utilized.

The controller cylinders are operated mechanically, and as the power required is quite considerable, an auxiliary compressed air

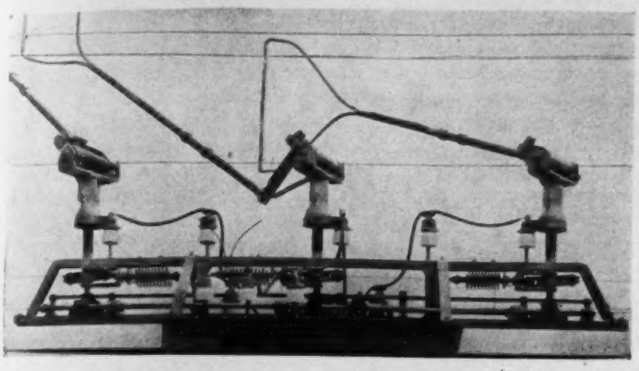


FIG. 11.—DETAIL OF CURRENT COLLECTOR.

mechanism can be brought into action. At all times, however, the motorman has perfect control over the cutting in and out of the coils.

As stated above, the motors receive a primary voltage varying between 1150 and 1850 volts. The resulting currents are sufficiently low to be easily carried by the contact surfaces, and especially if there is a separate controller for each motor. This has the added advantage that in case a motor becomes inoperative it can be cut out of the circuit by its own controller.

The varying voltage is obtained by means of the delta and star connections of the transformer secondaries of which there are two. Each transformer has its delta and its star connection switch. These devices are similar in shape, but differently connected. Four switches are placed together into one case which, for inspection, can be easily removed from the car. The lighter cases and apparatus are symmetrically arranged in the center of the car, while the heavy transformers are attached as closely as possible to the trucks so that the frame supporting the car body is well utilized. The switches are operated by air pressure, which is controlled by the motorman. The safety devices are likewise placed in the switch case.

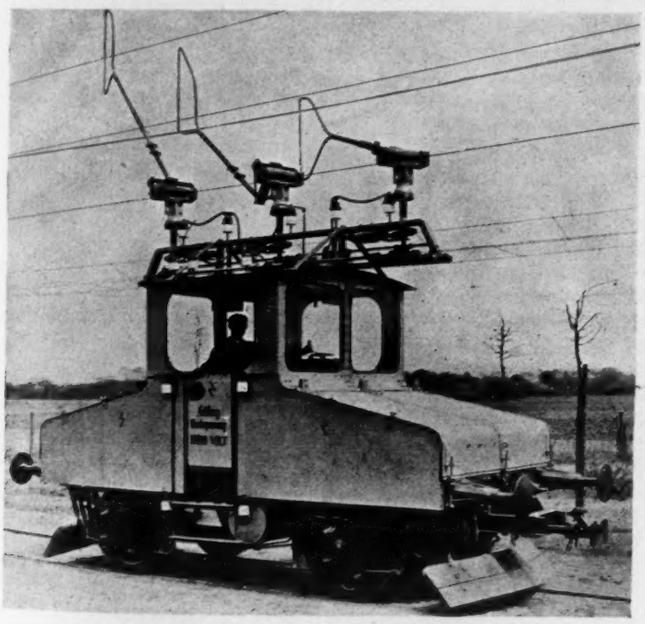
Each of the two transformers is not, as is usual, formed like an equilateral triangle, but the three legs are simply laid flat, next to each other. Their length, in order to be able to establish cooling currents, are coincident with the length of the car. In this way the transformers can be placed under the car floor. The primary, which receives a pressure of 10,000 volts, is permanently connected in star (Y) fashion, and is cut in and out by means of a high-pressure switch which is situated near the trolley directly beneath the car roof. The connections between these switches and the transformers consist of bare wires mounted on high pressure insulators, so as to facilitate inspection. They are run for a short space along the roof and then down an iron cable way, 500 mm. (20 inches) in width, which also serves for ventilating purposes. These cableways adjoin the walls separating the central from the end sections; the safety devices are located at the top of the cableway, and right above the wall separating the end sections from the platforms is an iron trough containing a small transformer for the air pump and a high pressure switch, all of which can be clearly seen in Fig. 6. These last named switches serve also for altering the direction in which the car is to run. For that reason only one of them is closed at a time and, as seen in the diagram, all the energy for the operation of the car must pass through this switch.

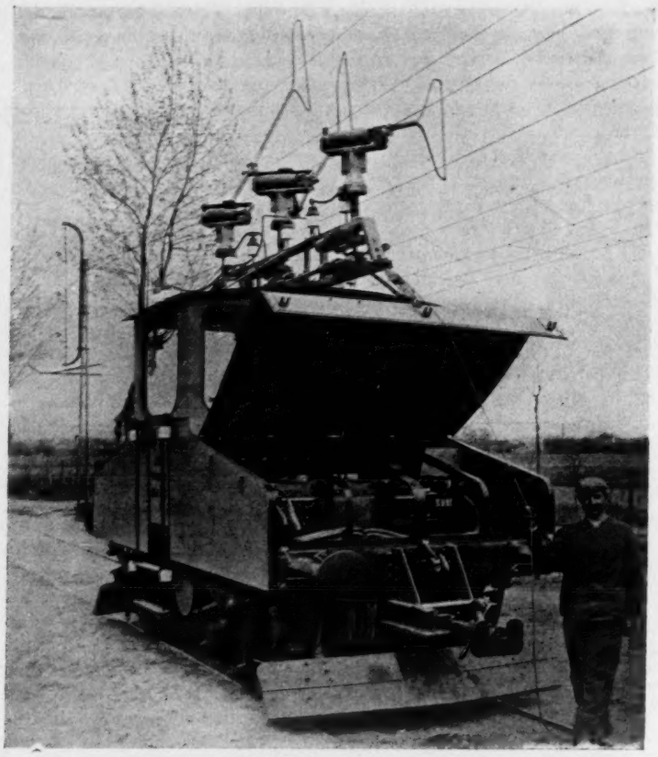
The current collectors, or trolleys, must operate without sparking if possible, and must be separated considerable distances from each other. As the trolley wires are suspended vertically beneath each other at the side of the track, the current collectors swing in a horizontal plane around a vertical axis. This axis consists of a stout pole which is almost directly over the center of the truck, measured from side to side, so that the current collectors do not have a very large reach. The trolley pole and its controlling mechanism reaches down to the motorman's platform, from which place it may be revolved in any direction.

The current passes from the contacts into collector rings from which it is taken off by means of brushes, which are connected by wires with the high-pressure switches. The upper part of the pole together with the collector rings can be taken off, while the lower portion remains in the car body in its bearings.

The air pumps are located under the motorman's platforms and are supplied with current from the small transformers, ratio 10,000: 110.

To the dashboard, in front of the operator, a switchboard is fastened, on which are located the various cocks which connect the air





FIGS. 12 AND 13.—LICHTERFELDE LOCOMOTIVE, SHOWING TROLLEYS.

pressure cylinders of the devices either with air pressure reservoirs or with the outside air. The cocks are turned in this order when starting up: "Forward," or "backward," then "motors" and "rheostat controller," and the reverse order when the car is to be stopped. On the board is also the cock for the Westinghouse brake, the switch for the air pump, and near the table the measuring instruments for air pressure, voltage, current and speed.

The car is electrically lighted by means of a storage battery and in case of necessity stearine candles can be used.

LINE CONSTRUCTION.

The trolley wires are suspended in a manner similar to that employed on the Siemens & Halske experimental road at Grosslichterfelde, ashown in Figs. 11, 12 and 13. The trolley poles are located 2¼ m. (7.38 ft.) from the center of the track and the three wires are each separated 1 m. (3.28 ft.) from each other. The lowest wire is supported 5½ m. (18 ft.) above the surface of the rails. The total line is divided into sections 1 km. (.621 mile) in length, and at the center of each section is an auxiliary feed connection. At the end each section is connected by means of an insulator to a heavy pole. The zero point of the system is grounded, i. e., it is connected with the earth and track. Lightning protective devices have been provided and in case a wire should break, the current is cut off from it, before it falls to the ground. The feeders are connected to the trolley wires in the neighborhood of Marienfelde (Fig. 1).

The above description sets forth the general scheme which has been followed in laying out this installation. In a following article the details of the system will be described, showing in what manner all the foregoing conditions have been fulfilled.

Public Co-operation in Perfecting Telephone Service.

By Joseph B. Baker.

IN an account of Superintendent Valentine's recent paper on the use of the telephone in the railroad service, stress was laid by the speaker, and, in discussion, by Mr. Henry W. Pope, of the Buffalo Bell Telephone Company, upon the fact that only a small percentage among the general public know how to use the telephone. The writer was struck by the significance and truth of this observation, and by the bearing of the underlying cause upon the general problems of telephone engineering as an art of quick inter-communication.

In the handling of trains by telephone, railroad men accustomed to electric communication by telegraph and with many years of practice in the oldest electrical art to make them "go in on the wire" for business and "get off the wire" when their business is through, may be relied upon to work out to the limit all the comparative advantages that may be inherent in the telephone. The discussion in the technical press, by practical railroad men, that has followed the paper cited above, is to the writer's mind an indication of the coming use of the telephone to the practical exclusion of the Morse. The pertinent point here is, that, as Mr. Valentine's facts and figures show, the use of the telephone by trained officials results in an enormous expedition of business. The same care that is liable to be a life and death matter when it comes to the handling of train orders, means brevity and dispatch in the co-operation of the officials with the telephone operators. In a word, efficiency and safety go hand in hand in the use of the telephone in railroading, and must win, for the use of a speaking telegraph over a signal telegraph, in the end. Why, then, may not efficiency and economy go hand in hand in the vastly greater volume of public use of the telephone?

For a long time the apparatus—the switchboard replaced with most costly frequency, lines and cables overhauled and renewed with ceaseless vigilance, the operators trained in the newest methods that "Bell" and "independent" skill can devise—has been kept up to date and most sensitively capable of saving the little intervals of time in operating that make such long periods in the aggregate. But is not the public user of the telephone very much the same as he was in the early days? Outside of the telephones connected to branch exchange switchboards, is not the average individual just as much inclined to appear at his mental and temperamental worst when talking into the "hole in the wall" as he was in the ancient days of Blake transmitters and "Hello, Central"? Does not the average telephone user co-operate less than formerly, rather than more, in too many instances, and is not this lack of co-operation a very real and heavy factor of loss in the telephone service? In this paper it is sought to be shown how important this factor of loss is in the handling of toll line telephone calls, or conversation between points connected by trunk lines between exchanges and carrying a toll charge based on the distance between the points and the time consumed in conversation.

In the course of every-day experience in the operating department of a telephone company handling toll line calls, many opportunities are presented to the public to vitiate and make of no effect the most elaborate and hair-splitting refinements in electrical and mechanical detail having time-saving for their object. In toll line calls the unnecesary delays introduced by any cause are of particularly bad effect on revenue, because they consume time in the use of an operating plant whose value is enormously increased over that of a local telephone company by the interest on amounts invested in costly line construction. Such a general statement may stand to represent the positively heartbreaking consumption of time that occurs at the busy periods in the telephone day due to perfectly avoidable, wholly unnecessary inertia or erratic behavior of the public when its members wish to talk over a long wire. An example borrowed from another field of electrical engineering experience in the operation of the Boston Elevated Railway may serve to emphasize the writer's meaning here. In the design of both rolling stock and permanent way by the very capable engineers who have carried into execution that up-to-date piece of work, a far-reaching effort to produce a quick schedule resulted, on the opening of the road to the public and for a long time thereafter, in no more than ordinary "rapid transit" for the tens of thousands of daily passengers; where it would seem that the carefully laid grades and curves, the powerful, quickly accelerated trains and the elaborate block-signal system ought surely to result in real rapid transit. Why is such consummate engineering skill made of on effect? Because the public do not "step lively" so as to make a schedule of getting on and off the trains that is in the same class with the schedule of moving the trains. Of what use, the officials of the road might ask, are the unparalleled acceleration and braking of the trains and the high speeds between stations, with a "practice train," making a five-mile run in 18 minutes, since the same trip takes all of half an hour, when the public increase the length of stops at stations so far beyond a reasonable time? It may be objected that modern American civilization asks us too insistently to "step lively." But that is another matter. The contention of the writer is that, given an engineering plant that is correctly designed either for rapid transit or rapid inter-communication for a public that demands rapid transit and inter-communication, is it not fair that the essential public co-operation should not be overlooked, and should not the securing of such co-operation by education of the public in any way be regarded as just as much a part of the broad engineering problem, as, for example, the proper distribution of block signals?

While it will no doubt be the good fortune of the Boston Elevated Railway management to be able after a while to give something like the quick service that their constructing engineer had planned, simply because railroad trains have a well-known way everywhere of leaving by the clock without waiting for belated individuals, yet the example cited may serve to illustrate the serious effect of lack of public co-operation. And in the case of telephone communication we are without the salutary corrective tendency of direct and positive reaction upon the offending individuals. For example, if a man does not use the plain co-operative faculty of being on time for his train to New York, he is left behind. The punishment is his alone, and the train, serving faithfully the hundreds who meet the simple co-operative requirement, makes the schedule time, along its disciplined course, which engineering skill provides. The transportation is there, if he can avail himself of it. His slowness or stupdiity does not affect the system at all as far as the public service provided by that train is concerned. But how is it in the case of his telephone message, where he does not, in the vast majority of cases, co-operate with the service and is not positively required to by the system of operation, and where his failure does profoundly affect the public service, a factor of loss militating against the benefits that ought to be expected from the costly plant of lines and apparatus and skilled labor just as any other fault in the system would do?

Take the case of a party in Boston calling New York. To begin with, he approaches the telephone in a spirit—conscious or sub-conscious—differing from that in which he would approach the railroad ticket window; in the respect that, while he knows he must there

comply with a very quick dispatch of his business of buying a ticket to New York, here he knows that the operaor will take his call—must take his call—in any way that he chooses to give it. He feels quite at liberty to tell her what he thinks she has to know in order to transact this business, in the order and with the emphasis on detail that the importance of the call to him suggests. He does not like delays on the telephone, and the seemingly arbitrary questions by several different operators coming in on the line in succession. He does not realize that when he has started the machinery of a toll line call by signaling his operator, he had far better allow the telephone company to run their business, which in this case is his business, and co-operate gracefully and intelligently by answering the questions put to him and preserving at least as good an attitude of patience as he would at the window of a bank-teller or of any ticket agent; and that, while he is devoting his sole attention and interest to getting this call, the telephone machinery with which he is dealing finds his call simply one of many; to give the best attention to all of which means of seemingly obvious necessity, an elaborate system of division of labor among operators and the divided attention of each operator. He does not realize that the operator with whom he argues has neither the time in her narrow round in a mass of the same work over and over again, nor the temper and brains that go with a larger salary than she gets as a wheel in the machinery, for anything whatever that takes her attention or vitality away from her own clearly defined duties. He fails to realize that the art of telephony as practiced for years by the telephone company may mean an application of the rule of "the greatest good to the greatest number"; that may not be fitted to always give him just what he wants in the time his fancy pictures ought to be sufficient. He does not remember that, though the telephone and switchboard are machines, the operator is not, but is human and quite likely very busy. Finally, to close my list with a reference to an absurd but very common error—he does not realize that in giving in his toll line call (for a party in New York) he is not talking with an operator located in that city.

All this friction—the lack of co-operation of the individual with the operator, just cited—means that the "recording" of a toll line call for transmission to the distant point, may take minutes where seconds suffice when the party calling is simply business-like. All that is needed for quick recording of any call is a prompt, clear and consise answer to the recording operator's question. The minimum time is attained, of course, when the party calling is accustomed to the use of his telephone on toll lines, and is putting in a frequently recurring call. In such a case, both the operator and the party calling understand an abbreviated formula soon pronounced. The long delays in recording come when the operator has to deal with a party who volunteers a copious flow of information from which she has to select the small kernel of essential matter, or with a party who cannot or will not understand the brief, simple questions put to him. Oftener than not, these two "cases" are combined in the same individual.

Delays in recording have been referred to for the purpose of general example of lack of co-operation by public users of the telephone; but, apart from the frittering away of operators' time and tying up switchboard apparatus, such delays are of secondary importance compared to those that take place when connection has been made to the toll line. The same kind of vexatious waste of precious seconds here and there, in delays by substitution of office boys for principals at either end of the line, in failures to ring off when through talking, in refusal to "talk up" when loud transmission is required to reach the end of a long line, but they are vastly more expensive. In the aggregate, on a single call, they may mean many minutes out of the total "elapsed time," shown on the ticket, that cannot be charged for, but that should have carried their revenue. Here it is not a loss of operators' wages plus interest on the switchboard. It is loss of use of toll lines when revenue calls are clamoring for the lines at busy periods; it is the interest on the cost of a 500-mile pole line built over an expensive right of way with the best lake copper and chestnut poles, with some costly and short-lined cables figured in. It is to be borne in mind that toll line telephoning is radically different from telegraphing in the fact that it is the bringing of two particular parties together at the ends of a wire, and not merely the transfer of a message in one direction, and later, perhaps, a reply message in the opposite direction. The telegraph engineer's problem in heavy traffic is to handle a ruck of outward messages at a given office and another ruck of inward messages, and, moreover, he has some opportunity to "distribute the load," in both cases, to relieve busy periods. But the case of toll line telephoning is different and far more difficult, in that the revenue is derived from a message-and-reply communication as a unit, in a minimum of time from the receipt of the call at the outgoing point, and at any time of the day or night that service is called for, at which time the said message-and-reply communication completely monopolizes an electrically continuous pair of wires between the two telephones without the feature of step by step repetition that is often of such economic service in handling telegraph traffic.

The writer has had no thought of merely railing at a "necessary evil," but has desired instead to call attention to a contrast between highly organized apparatus and a widespread incompetence on the part of the users of that apparatus. The system of telephony that has been built up in this country of its birth is one that permits the careless public user to affect its efficiency by his lack of it, to the detriment of the service. Surely any gross imperfection in the working of an engineering plant ought not to remain a necessary evil. The telephone has been with us long enough, has reached a sufficiently high state of perfection and universality, to command a public co-operation at least on a par with the public confidence in its use. Is it not time to give some of the attention that has been so wonderfully exercised in the past in the saving of fractions of a second in switchboard operations to the systematic education of the public? Is it not time to train that other and vaster body of "telephone operators," the public? Has not the time come for standard and common-sense procedure everywhere? In this article it has been sought to point out the need of such standards and of common sense, the complete understanding and practice of which ought not to wait for monopoly of toll and local lines over the country.

Heat Distribution in the Electric Furnace.

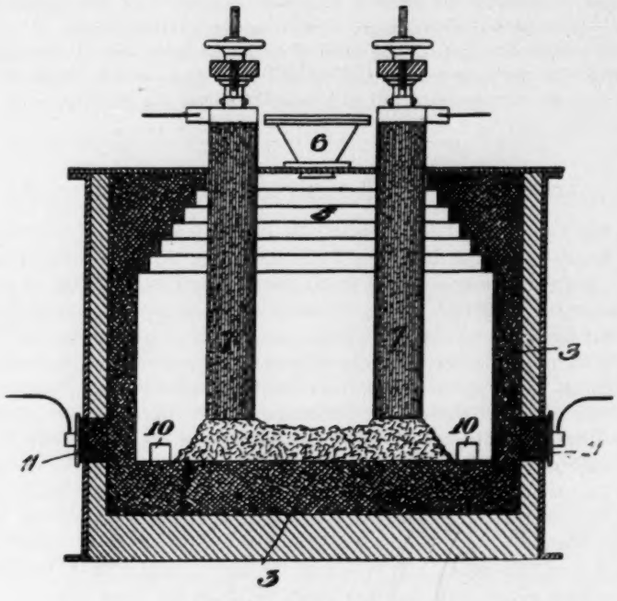
The expression, "the chemistry of high temperatures," has been a favorite one with investigators as indicating the field covered by the electric furnace—the whole classes of reactions, whether of reduction or synthesis, which lie beyond the range of temperatures attainable by the combustion of carbon. It is only recently that it has been fully realized by chemists that the reactions so indicated occur at temperatures which are considerably below the utmost attainable limit of the electric furnace, and that the effects of excessive heat must be as carefully guarded against as in the more familiar metallurgical processes. Calcium carbide is prone to dissociation with most troublesome results, both as regards the grade of the product and the clouds of dust which follow the combustion of the volatilized metal. Carborundum, at a somewhat higher temperature than that which suffices for its formation, breaks down, leaving a residue of graphite, and it is becoming more and more common to state, of any given reaction, not that it can be accomplished in the electric furnace, but that it may be effected by the heat developed by a given current under specific conditions. It has been found, in short, that the element of temperature control is exceedingly important, and that the intense and localized heat of the arc is not the most favorable for the accomplishment of quantitative results on a commercial scale.

The resistance furnace is more readily governable, and has grown correspondingly in favor. If, however, the heat be developed by the passage of the current through a mixture of carbon with the ore to be smelted as in the Cowles furnace, there are violent fluctuations due to the changing conductivity of the charge as the smelting operation proceeds. When the product of the furnace is alone relied upon to carry the current, the field of operations is necessarily greatly restricted, for it is essential to such work that the product be capable of being tapped off to maintain a conductor of constant cross-section, and also that it afford sufficient resistance to the current to develop the necessary temperature. Clearly but few furnace products possess both of these essential properties. If, as in a third class of resistance furnaces, the current be carried by conductors, either of carbon or a suitable refractory metal, which are independent of the charge, the ideal conditions as regards control are approached, but such furnaces are relatively expensive to construct and maintain, for the resistance is an additional and perishable element.

De Laval, of Stockholm, about 1892, invented a type of resistance

furnace differing from all of these and offering many points of advantage, a type which might appropriately be termed the "electrolytic furnace." In this construction a fused electrolyte is traversed by an alternating current, and the heat thereby developed is employed for the reduction of a suitably prepared charge. This furnace was designed chiefly for the reduction of iron ores, and as an electrolytic resistance a body of fused magnetite was interposed between separated lateral masses of molten iron constituting the terminals. Iron ores, mixed with carbon, and introduced into this electrolyte become reduced, the metal accumulating in the lateral pockets which contain the terminals and being tapped therefrom to maintain a constant volume.

A patent issued Aug. 27 to Mr. Hugh Alexander Irvine, of Niagara Falls, N. Y., represents an extension of the De Laval method to the production of volatile elements, and particularly to the manufacture of phosphorus. The furnace, as shown in the accompanying figure, consists of a hearth and side walls 3 of packed carbon, surmounted by an arch 5 and feed-hopper 6. Carbon electrodes 7, connected to opposite terminals of the source of electricity project through the cover of the furnace and into proximity with the hearth, the circuit being at first closed through a mass of granular coke, as shown, but in further operation by a layer of conductive slag, derived from



IRVINE ELECTRIC FURNACE.

the charge itself and maintained constant in volume by tapping the excess through the top-holes 10.

In operation a charge consisting of a mixture of phosphate rock and carbon, with an added flux to form the conductive slag, is fed into the furnace and the circuit closed. The flux may be basic, acid or neutral, according to the character of the phosphate treated, the essential point being that it shall determine the accumulation of a fused electrolyte in quantity sufficient to cover the furnace hearth and to provide a path for the current between the carbons. Upon this molten bath of slag the remainder of the charge rests, and is progressively smelted by the uniform and moderate heat developed by the resistance of the electrolyte. Terminals 11 in electrical connection with the hearth are provided in case it should become necessary to change the path of the current for any purpose.

These electrolytic furnaces are essentially continuous in operation, for the slag and charge are non-conductors when cold, and if the furnace were allowed to cool difficulty would be experienced in again starting it. An obstacle inherent in the type of furnace, and one which will probably prevent any extended application of the principle, is the difficulty of securing a lining material for the hearth which shall be infusible, neither fluxed nor oxidized by the supernatant slag, and at he same time so highly resistant as to carry no appreciable proportion of the current. It would seem doubtful whether "packed carbon" is fully capable of meeting these conditions.

The Control of High-Potential Systems of Large Power.*

BY E. W. RICE, JR.

The enormous increase in the use of electricity for lighting, traction and power has necessitated important changes in our generating stations. As the areas to be served have rapidly increased, corresponding increases have been made in the size of these stations and in the electrical potentials employed. The change has been due, not only to the great natural growth but to the consolidation of generating machinery into fewer stations. Instead of a number of separate stations, containing relatively small units producing electricity at comparatively low voltage with relatively large transmission losses, we now frequently find one large central station, containing generating units of great size delivering electricity at a high potential. Dynamos of 2000 to 5000 kilowatts capacity are displacing those of 200 to 500 kilowatts, and pressures of 5000 to 15,000 volts those of 1000 to 2000 volts. The design and manufacture of large generating units of this character have called for engineering skill of a high order, and it can now be fairly claimed that the production of such machines has been reduced to an exact science.

The rapid evolution and present perfection in dynamo design have been due to the skill with which the various problems have been solved by the designing engineers and to the ease with which the data based upon machines of relatively small size were applied to those of larger size.

It is evident, however, that great advances in the capacity and voltage of generators would be useless, if not positively dangerous, unless adequate means for controlling and switching the electrical current were at hand. The evolution of the dynamo was for a time more rapid than that of the devices for controlling and switching currents of large volume and potential. As a result, a number of machines of large size were placed in operation with comparatively inadequate methods of switching and controlling. The energy and power which can be safely concentrated in a single central station is obviously limited by the amount of current and voltage which switching devices can safely handle. This fact was especially forced upon the attention of the writer at the time when the company with which he is connected took the contract for the equipment of the generating station of the Metropolitan Traction Company, of New York. This station was to contain 11 three-phase dynamos, each of 3500 kilowatts output at 6600 volts. In order to realize the full economy of such a station, it was, of course, necessary that all the generators should supply current to a common bus-bar, and that from these bus-bars the current should be distributed through feeders to a number of sub-stations. The sub-stations were to contain rotary converters, frequently working in multiple with large storage batteries on the direct-current side. The characteristics of such a load prevented any reliance being placed upon the opening of the exciting circuit of the generators in case of the necessity of a general shut down, as the rotary converters would, under certain conditions, supply sufficient magnetizing current to excite the generators, even with the field windings of the generators unexcited. It became, therefore, essential to produce a switching mechanism which would enable the generators to be connected and disconnected from the bus-bars with certainty and safety under all conditions of load, even up to a short circuit, and also that the various feeders supplying the sub-stations should be capable of the same treatment. Three types of switching devices were available for this work and were carefully considered:

1. Switches breaking the circuit in the open air.
2. Switches arranged to break the circuit in an enclosed air space.
3. Switches arranged to break the circuit under oil.

Switches of the first type (open air) were impracticable, because the space demanded to make such switches operative could not be provided.

Switches of the second type (enclosed air) had no such limitation, but oil break switches were found to meet the conditions more perfectly. Tests conducted showed that energy up to 2000 to 3000 kilowatts could be controlled in a single oil switch at potentials as high as 15,000 volts, which was the limit of the apparatus at our disposal at the time. Switches of this type, however, as large as was considered necessary, required an amount of oil per switch so great as to be objectionable, in view of the large number of switches required

*A paper read at the Buffalo Convention of the American Institute of Electrical Engineers.

for generators and feeders. The problem then was to produce a switch which would retain all the advantages of the usual oil switch and at the same time minimize the quantity of oil.

The type which was finally evolved and employed in the Metropolitan installation has shown itself in practice to be remarkably successful. It is known as the Form "H" Oil Switch by the manufacturers, and was designed by the writer, with the assistance of Mr. E. M. Hewlett. It was described by Mr. J. E. Woodbridge in the ELECTRICAL WORLD AND ENGINEER of April 14, 1900. Reference to this article will give the details, which I need not here repeat. I shall simply outline the principal features.

The switch, as designed for three-phase circuits, consists of three double-pole, single-phase switches, or elements. Each single-phase switch is contained in a fireproof cell, but all three switches are designed to be operated simultaneously. Each single-phase element consists of two brass cylinders or cans, one can for each pole. The in-coming lead is attached to one of the cans and the out-going lead of the same phase to the other. Each cylinder is nearly filled with oil and is covered by a metal cap which carries a long insulating sleeve. Two copper rods joined by a metallic cross-head and forming together a U-shaped conductor, slide through the insulating sleeve and fit into tubular contacts at the bottom of the cans when closing the circuit. The cross-head of each U-shaped conductor is atached to a wooden rod, which extends through the top of the cell or casing which encloses the switch, and is in turn attached to a metal cross-head operated by an air motor or an electric motor, as the case may be. The three-phases are seen, therefore, to be broken or close simultaneously. When the three sets of U-shaped conductors are lifted, the circuit is broken under the oil at two points in each phase, or six points in each complete three-phase switch. The range of movement of the cross-head varies with the potential to be controlled; it is 12 inches in the switches in the Metropolitan station for 6000 volts, and 17 inches in the switches for the Manhattan station for 12,000 volts. The brass cans are lined internally with fiber to prevent the arc from jumping from the rod to the metal of the can when it is drawn up through the oil. Each switch unit stands alone on its own foundation, with the three phases in three separate cells or spaces separated by brick walls. These brick partitions act as barriers and prevents any possible burn-out in one cell from spreading to the others. As an opening of two legs breaks a three-phase line, an arc in one cell will not incapacitate the switch. The circuit breaker or switch differs radically from older forms in the separation of the phases as indicated, and also in the separation of the contacts for each phase, in two separate oil pots. This separation of the terminals of each phase gives two separate arcs, each enclosed in a space well removed from the others, so that the possibility of an arc communicating from one pole to another is obviated. It will be seen that in breaking a three-phase circuit, the arc is produced in six independent oil pots. This method of construction, together with the separation of the phases in separate fireproof compartments, accounts for the unusual effectiveness of the switch in practical operation. The general construction of the switch is clearly shown in the accompanying illustration.

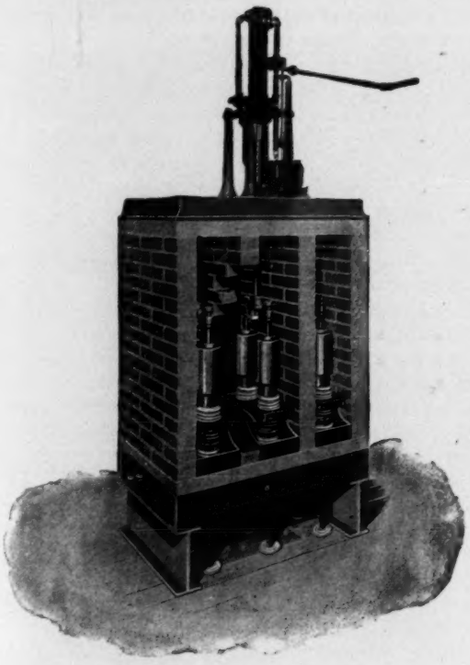


FIG. 1.—PNEUMATICALLY OPERATED SWITCH.

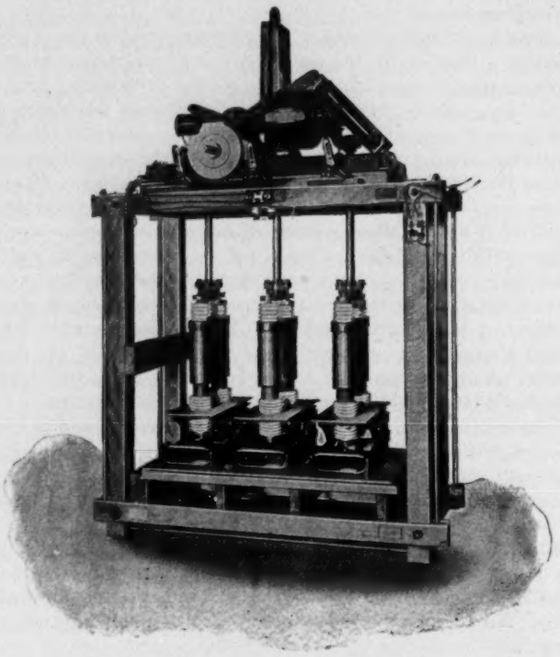


FIG. 2.—ELECTRICALLY OPERATED SWITCH.

Fig. 1 shows the switch used in the installation of the Metropolitan Traction Company, New York. It is designed for 6600 volts and 300 to 800 amperes.

Fig. 2 shows the same switch as modified to suit the conditions of the Manhattan electric installation. On account of the higher voltage the oil pots are larger and a larger opening of the circuit is provided. The 12 covers for the oil pots are replaced by porcelain. It is designed for 12,000 volts and 300-800 amperes.

Fig. 3 illustrates the enclosed air tube type of switch already mentioned. This switch has given most excellent results on high potential work.

Fig. 4 shows a form of tank oil switch, without the tank for containing oil.

Fig. 5 is a reproduction from a photo taken at Kalamazoo of a special form of open-air switch. The switch was opening a circuit of 25,000 volts and 60 amperes at the time when the photograph was taken.

It was at first thought that the use of oil switches for the control of high potential circuits would possibly result in reasonance effects, particularly in circuits containing considerable capacity, such as underground cables or long overhead lines. A number of experiments have been conducted and the weight of evidence seems to be in favor of the oil switch as avoiding these effects. It has been found as an interesting fact that under the conditions described considerable disturbance due to resonance may occur upon the *closing* of a circuit. This is naturally independent of the character of the switch employed; it may occur equally well with an oil, an enclosed air, or an open air switch.

Upon the rupture of the circuit, however, the results obtained from many tests indicate that open air switches are liable to produce heavy resonance effects while the enclosed air and the oil switch are practically free from such effects. Extensive experiments to determine this point were conducted prior to the production of the switches for the Metropolitan and Manhattan stations. Very recently experiments of a more severe character have been conducted at Kalamazoo, Mich. These tests were made at from 25,000 to 40,000 volts, with from 1200 to 1300 k. v. a. of highly inductive load, the

power factor being 40 to 60 per cent. The switches tested were the cylindrical oil switch, already described (Metropolitan type); an oil switch in which all the terminals were enclosed in a single tank of oil, called the tank oil switch; a switch of the expulsion air tube type; and an open air switch in which the terminals were simply separated long distances in free air. In making these tests an oscillograph was used to determine the time of break and other interesting effects, and a camera to photograph any particular instructive phenomena.

The long break open air switch, which operates upon the principle of drawing a long arc in the open air, opened the circuit at 25,000 volts, but required several seconds of time and drew such a long arc as to be impracticable. At 40,000 volts the arc held and flared to a total distance of over 30 ft. until it struck the line and short circuited the system, producing at the same time high voltage oscillations equal to two or three times the normal potential of the system. It would therefore seem that the open air switch was generally unsuitable for the control of high voltage systems of large power, as even where sufficient room is available for their use, the production of high resonance effects tends to endanger the system. These tests also show that wherever a short circuiting arc occurred in the open air, electric oscillations of high voltage resulted. These were probably due to the rapid alternate extinguishment and formation of the arc during its period of interruption, the arc acting somewhat in the manner of a Wehnelt interrupting device. The dangerous character of short circuiting arcs emphasizes the need of the precautions which I shall mention in this paper, having in mind the avoidance, as far as possible, of such accidental short circuits.

The expulsion tube air switch operated up to 25,000 volts, but failed at 40,000.

The tank oil switch operated satisfactorily on 1200 to 1300 k. v. a. up to 25,000 volts, but at 40,000 volts it spat fire and occasionally emitted black smoke, thus seeming to be working at the limit of its capacity. No attempt was made to open short circuits with the tank oil switch.

The cellular oil switch never failed to open 1200 to 1300 k. v. a. at any voltage up to the maximum employed, 40,000; the circuit opening noiselessly and without the appearance of fire or emission of smoke

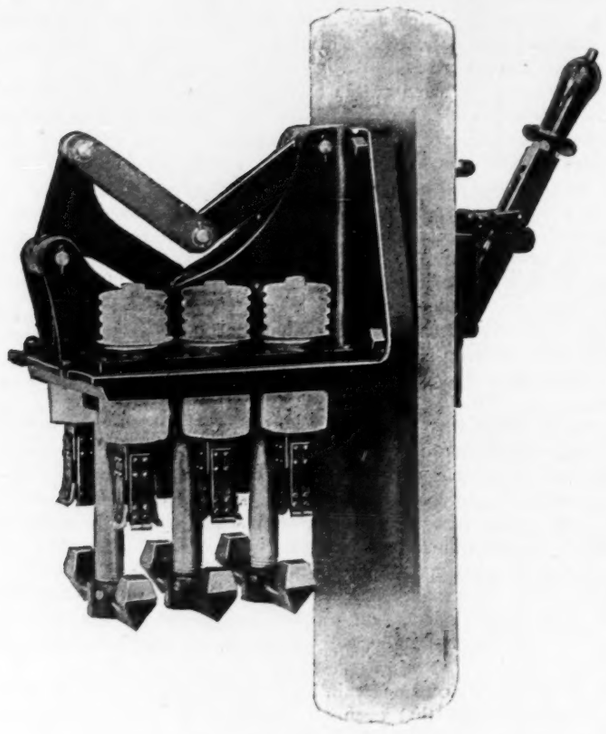


FIG. 3.—OIL BREAK SWITCH.

at the switch. It was used as an emergency switch in all the tests to open *short circuits* on 25,000 to to 40,000 volts. The results of these and other tests, and the continued effective operation of the cellular type switch in the Metropolitan station indicate that this type of oil switch will safely control circuits of practically unlimited power at potentials considerably above 40,000 volts, probably as high as 100,000 volts.

The character of the break when operating properly was the same

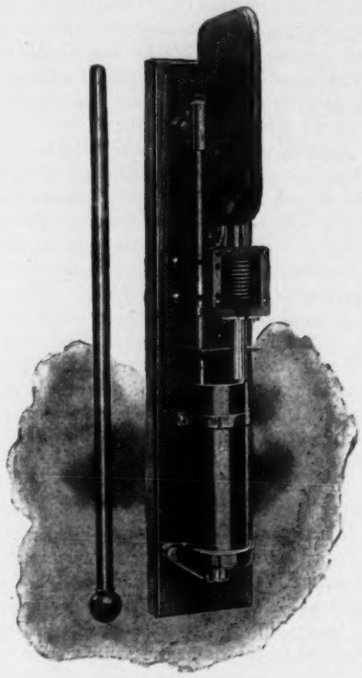


FIG. 4.—EXPULSION TYPE SWITCH.

in all the switches except the open air type. In opening, the arc held for a number of half waves from 6 to 18 and then broke at zero value without disturbance of the system. With the oil switches no traces of oscillation were noticed before the break, and no traces of rise of voltage. With the expulsion air switch, traces of oscillation were seen for a number of half waves before the final break and in consequence a slight voltage rise occurred.

I will not attempt to describe the numerous observations made at the Kalamazoo tests, as these will undoubtedly be given to you by our president, who supervised these tests and to whom I am indebted for the information which I have given regarding them.

In addition, however, to the production and use of a switch which will be as safe and reliable as engineering skill can make it, there are certain other factors which should be considered in connection with the control of current for high potential stations which should be taken into consideration by the electrical engineer. It should be constantly kept in mind that no apparatus can be absolutely free from accident, no matter how carefully designs are constructed. The engineer should, therefore, carefully consider the possible effect of any accident with particular reference to the possibility of an accident to one element involving other apparatus. The layout should be such that an accident to one element could not of itself, or in consequence of a chain of accidents, result in a breakdown of the entire generating station, even for a short time.

The mechanical engineer has considered this point and met it with a fair degree of success in the large modern central station with the fireproof boiler house and the frequent sub-division of this boiler house into two or more portions by suitable fire walls, as in the case of those of more than one story.

The general employment of a duplicate system of steam piping, or its equivalent, also provides a reasonable safeguard against failure of supply from accidental disarrangement of a steam system. The steam engines in well arranged stations, being important units, are placed a sufficient distance apart, and so disposed, generally, that an accident to one will not easily involve other units. This is also true of the dynamos which are directly coupled to the engines.

The switchboard with its switches for controlling and appliances for measuring the output of the generating station, the cables leading from the generator to the switchboard, the location of the busbars, and the disposition and arrangement of the feeder cables for distributing the current, have not, as a rule, been given that serious

attention which their importance deserves; in fact, the consideration of the electrical controlling devices and the wiring of the station has been apparently left to the last, and it is frequently the case that a generating station containing apparatus of great value has been jeopardized by the lack of careful design of the switching appliances. Stations designed to deliver a normal output of from 5000 to 10,000 kilowatts, at relatively high pressure, say, 5000 volts or upwards, frequently contain switches for controlling the generators and the feeders mounted upon the face of a long continuous panel, and so crowded together that in case of failure to open the circuits the resulting arc would be almost certain to involve adjacent switches and even possibly cripple the station for a time. The bus-bars are also often so disposed that an arc may easily start thereat or at least so that an arc, if started for any cause, would be liable to seriously damage the switchboard.

The same methods frequently obtain in regard to the manner of installing the conductors; high tension and low tension conductors being often mixed together and the conductors so arranged that in case of any injury to one, other of the conductors leading from the generators or from the switchboard out of the station are in danger of being involved.

These methods have probably arisen from the fact that up to a comparatively recent period the service of a city for lighting and for power has been separated among a number of different stations, each of a relatively limited amount of power. In case of the failure of any individual unit in such case, as of the generator, switchboard, or other apparatus, the damage was small, owing to the limited energy available. A shut down, even of the whole station, was comparatively unimportant. However, the case is quite different with the large modern station with output of from 10,000 to 100,000 horsepower, which is designed to supply electrical energy for a large portion of a city's needs, combining frequently electric power for traction purposes, for lighting, etc. The economies expected of such stations—lower cost of operation, smaller investment and greater economy in coal and in steam—due to the better load curve obtained by the concentration of loads of large area and of various character in one station, as well as to the higher efficiency of the large units, are familiar to all electrical engineers. I am inclined to think, however, that the possible dangers of such a concentration of energy have not been fully realized. The failure of such a station, even for a brief period, would be a disaster which, with proper design, need not occur.

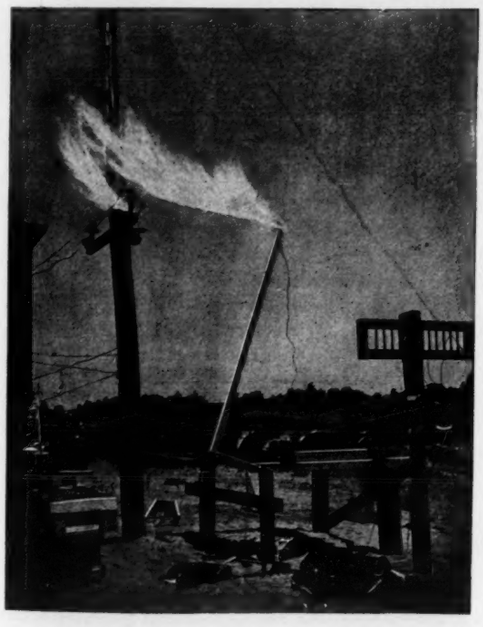


FIG. 5.—EXPERIMENT WITH AIR BREAK SWITCH AT KALAMAZOO.

I will briefly outline the principles which I believe should govern in the layout of such a central station, the details of which may naturally be varied considerably to suit local conditions. It should be kept in mind that I am discussing stations of normally large output, say, 5000 kilowatts and over, although many of the principles mentioned could probably be applied with advantage to stations of smaller size. Broadly speaking, I would carry the principle of subdivision into units as far as practicable; the units to be chosen with respect to the size of the station, character of load curve, etc. The boiler house, as already stated, should be sub-divided into two or more distinct portions, so that injury to one will not involve the entire steam system. Fortunately, the foundations, masonry and mounting of boilers are so essential and of such a nature that damage to one unit is not liable to involve another. At the same time, it is important that the boiler house should be divided into two or three sections, separated from each other by brick partitions. The steam piping should be in duplicate or a substantial equivalent, and so arranged that the bursting of a steam main cannot flood all the boiler rooms with steam or stop the entire flow of steam to the engine room. The engines, with the dynamos coupled thereto, may be placed in one large room, provided this room is of sufficient size to enable the units to be placed at proper distances apart. The switchboard should preferably be placed in a separate room, so that any accident to the engine or to the steam piping will not injure the switchboard operator or the switchboard mechanism. The electrical conductors from each dynamo should be led to the switchboard as far apart as possible from those of other units. Each set of conductors should be led to its own switch. Each switch should be of ample capacity to interrupt the entire output of the generator at full voltage and even take care of the concentration of the entire load of the station, as in a short circuit. This switch should be placed in a cell of fireproof material and preferably electrically controlled from a central point. If so disposed, these switches may be placed reasonably close together, but the partitions should be such that any one of the switches could arc to destruction without involving the switch of a neighboring generator. Switches should be in duplicate, so that in case of failure of one, another switch will be in readiness. Especial care should be taken, in leading the conductors from the switches to the bus-bar, to keep the conductors as far as possible from those of neighboring units.

The bus-bar or bars should preferably be in duplicate, or some equivalent arrangement such as sectional sub-division, should be adopted. Bus-bars should be carefully protected in fireproof compartments so arranged that it would be impossible for any arc to short circuit from one conductor to another or for it to be injured by an arc caused by the destruction of any of the generator or feeder switches. The same care should be taken to isolate the conductors leading from the bus-bars to the feeder switches. The feeder switches should also be in duplicate; that is, two separate sets of switches on each feeder in series with each other when feasible, or the conductors leading to a group of feeders may be joined together by a switch placed in series therewith controlling a group of feeders. Each group switch and each of the feeder switches should be mounted in its own separate fierproof compartment and preferably controlled electro-magnetically from a distance. The conductors leading from the feeders out of the staion should not be massed together in one conducting trench or well, but should be sub-divided into as many groups as circumstances will permit.

The constant aim throughout the entire station should be to limit the normal flow of energy in a given space to a predetermined amount, preferably for example, to that of the generator unit which has been selected, or in the case of the feeders leading outside the station the normal flow of a group may be limited to that delivered to any one sub-station.

It is obvious that the arrangement of switchboard, as described will occupy more space than the ordinary panel type. The total space occupied, however, is but a small portion of the total space required for the generating plant, and it is believed that the precautions recommended are essential to the continued success and reliability of large generating plants. Such separation of the switches, etc., makes some method of control from a distance very desirable. The motors used for operating the switches may be either pneumatic or electric. The control of these motors should preferably be electric in all cases. By adopting electric control from a distance, it is possible to combine all the switches required for the generator, feeders, etc., upon a small keyboard under the observation and control of a single operator. It is also possible to place this operator in such a position that he will have a comprehensive survey of all the measuring and controlling devices needed for the station, and at the same time be free from danger in case any of the apparatus should fail to perform its work. Under such circumstances the operator is much less liable to make a mistake, and it is believed that having taken

such precautions accidents even of a trivial character will be more unlikely to occur. In laying out the electrical devices for such a station the utmost simplicity should be aimed at; not a single instrument, conductor or switch being placed in the station that has not been carefully considered and felt to be essential. It is better to err on the side of simplicity than of complexity.

Power Factor Indicators.

THE Institute paper of Professor William Hand Browne, Jr., on the above subject, opens with an examination of the principles involved in power factor instruments for use on circuits where it is desirable to balance wholly or partly the wattless component of current due to induction motors, by the use of synchronous motors or converters. It is shown that measurements for determining the phase angle are unsatisfactory when involving the cosine, if the cosine approaches unity. We must measure either the phase angle directly or indirectly, or what in most cases would be equally satisfactory, the wattless volt amperes; that quantity Mr. Steinmetz has called the "wattless power."

Unfortunately, few of the methods suggested for measuring these quantities are more than laboratory methods, and the instruments used are unsuitable for practical work. The split dynamometer of Blakesley, the three-voltmeter method of Fleming, and the three-ammeter method of Sumpner are too familiar to need description, and are hardly applicable under the usual operating conditions. There are, however, two or three instruments which give satisfactory service under proper conditions.

Power factor indicators are classified in the paper under four heads:

1. Phase meters, by which the phase angle is determined directly.
2. Power factor meters, measuring a function of the phase angle.
3. Wattless power meters, measuring $E\ I \sin \phi$.
4. Wattless current meters, measuring $I \sin \phi$.

In the first class there may be included, in addition to types to be described below, all forms of oscillographs and curve tracers. The second class may include all instruments measuring sin ϕ and tan ϕ as well as cos ϕ.

These classes may be further sub-divided, according to the means employed to obtain an indication, into four types:

(*a*) Electromagnetic, using the force of attraction of electromagnets.

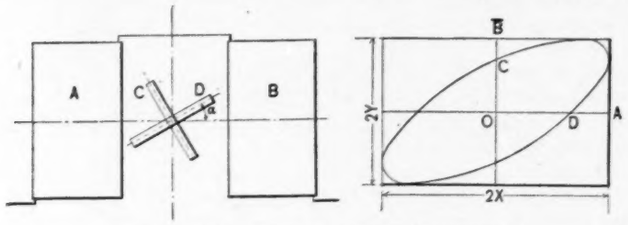
(*b*) Electro-dynamic, utilizing the reaction between coils carrying currents.

(*c*) Induction, a rotating magnetic field is set up and used to deflect a disk.

(*d*) Electrolytic, depending upon electrolysis to secure a record.

Phase Meters.—The various types of oscillographs and curve tracers are too well known to need description. In general they are laboratory instruments and not applicable to commercial working.

Tuma's Phase Meter (1*b*).—Let the pair of coils A B (Fig. 1)



FIGS. 1 AND 2.—POWER FACTOR INDICATORS.

carry the current whose phase angle, referred to the e. m. f., is desired.

Within the space between the two, suspended freely, is the movable system C D, consisting of two independent windings connected together mechanically at right angles. Let a be the angle which D makes with the axis of A B.

The paper then proceeds to show mathematically that a is the phase angle.

Induction Phase Meters (1*c*).—If we pass through two coils, concentric but set at an angle with each other, currents which set up equal fluxes differing, however, in phase, a rotating magnetic field of elliptical form will in general be created. If the two coils are inclined at an angle which is the supplement of the phase angle, the resulting field will have a constant value. An armature suitably placed in such a field will cause a ray of light reflected from an attached mirror to travel in a circle. In applying this method it is necessary to have the fluxes of equal value and to change the angle between the coils until the ellipse becomes a circle when the phase angle is read off directly. The instruments of Angelmeyer, Korda, Hess, Rossi and one of Arno, make use of this principle.

Electrolytic Phase Indicator (1*d*).—A very simple device, due to Janet, consists of a metallic drum upon which rest two styli of iron. One of these is connected so as to have a difference of potential between it and the drum which is in phase with the current, the other one being in phase with the e. m. f. On the drum is stretched a sheet of paper which has been soaked in potassium ferrocyanide and ammonium acetate.

When the difference of potential between either stylus and the drum reaches a certain positive value, electrolysis begins and the paper under that stylus turns blue. Now, if the drum be turned, each stylus traces a broken blue line on the paper, each blue mark representing part of a positive half wave. The angular distance from the center of one of these short lines and that of the corresponding mark made by the other stylus, expressed in electrical degrees, is the phase angle. This is true only when the two waves have the same form.

Powr Factor Meters (2).—Two harmonic motions acting at right angles and having the same frequency and amplitude, but a difference in phase of 90 degs., will produce, if acting at the same time, a uniform circular motion. If the amplitudes are not the same, the result is an ellipse, the major and minor axes of which are the respective paths of the two harmonic motions.

If the phase difference is not 90 degs. the two axes of the resulting ellipse do not coincide in direction with the two harmonic motions.

Puluj's Power Factor Meter (2*a*).—The principle just described has been made use of by Puluj. Two electromagnets, through the winding of each of which, one of the currents, the phase difference of which is desired, is passed, act upon two armatures causing them to vibrate in planes normal to each other. A ray of light falling upon a mirror attached to one of these and reflected to a second mirror on the other, and thence to a screen, will describe an ellipse, the shape and position of which is determined by the values of the two currents and the phase difference. Referring to Fig. 2, it is shown in the paper that $\sin \phi = OC/OB = O\eta/OA$.

Morland's Power Factor Meter.—In an apparatus described by Mr. Morland, the two conductors carrying the two currents pass between the poles of a permanent magnet. Each of these causes a small mirror to vibrate, producing the result just described.

Claude's Power Factor Meter.—Claude places the two electromagnets in direct opposition and causes them to actuate the same armature. Let the maximum flux set up by each coil be N. The ray of light reflected from the mirror will, under the influence of the flux N, oscillate along a path in length $K\ N$, K being a constant. If both coils were acting and if the currents were in phase, the length of this path would be $2\ K\ N$. Call this d_1 and the path of the ray d_2. Then it is shown that

$$\frac{d_2}{d_1} = \cos \frac{\phi}{2}.$$

It is evident from what has been said above that this method will not be accurate when ϕ approaches zero.

Rayleigh's Power Factor Meter (2*a*).—Lord Rayleigh's apparatus for measuring phase angles is somewhat similar to the above. The movable loop is replaced by a soft iron needle and the two coils are placed on opposite sides of this.

The deflections are measured as in a reflecting galvanometer. Mr. Edwin Place gives the results of a great number of experiments made with an instrument of this type. He shows that the angle found in this way is that between the equivalent sine waves. The cosine of this angle, however, is not given by the ratio of true watts to volt amperes, the true power factor.

Tuma describes an instrument similar to the above, but with the coils at right angles. One of these lies in the magnetic meridian.

He shows that, with specially wound coils, if ϕ is the phase angle and ϕ the angle between the needle and that coil which lies in the magnetic meridian, then $\cos \phi = \tan 2\ \psi$

Dynamometer Types.—A Siemens electro-dynamometer having two fixed coils may be used for phase angle measurements if the movable system be replaced by a coil closed upon itself and suspended in the plane of the other two. Suppose that with one current flowing in one of the coils the angle of torsion to keep the movable coil in its zero position is d_1, and with the other current flowing in the other

coil it is d_2, and with both currents flowing at the same time the angle is d_3. Then $d_1 + d_2 - 2\sqrt{d_1 d_2} \cos \phi = d_3$, from which the phase angle can be deduced.

Arno's "Tangent Phase Meter" (2*b*).—A second power meter of Arno's consists of a Siemens electro-dynamometer with an additional pair of coils closed upon themselves and fastened together at right angles. The pair, as a whole, is suspended within the two other coils and may be held in any position by a torsion spring. In Fig. 3 let A

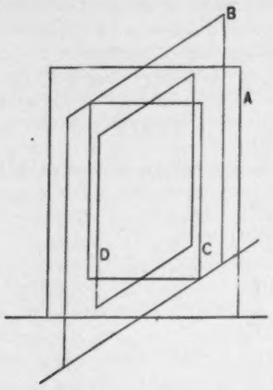


FIG. 3.—POWER FACTOR INDICATORS.

and B be the two coils of the dynamometer and C and D the pair of short-circuited loops.

Passing the two currents through A and B, respectively, the instrument becomes a wattmeter, and d_1 is the angle of torsion required to keep the movable coil in position.

Now, fix B and pass one current through A, and the other through B. Let d_2 be the angle corresponding to the couple between A and B; then $\tan \phi = K \frac{d_1}{d_2}$.

Breitfield's Method (2*b*).—Mr. C. Breitfield has suggested an application of an ordinary wattmeter for measuring the power factor of a three-phase system. The current coil is placed in one line and one end of the pressure coil also connected to this line. The other end is first connected to the second line and then to the third. In the first case we have the deflection of d_1, and in the second a deflection of d_2. Then $\tan \phi = \sqrt{3} \left[\frac{d_1 - d_2}{d_1 + d_2}\right]$

General Electric Company's Instrument (2*b*).—The well-known fact that the ratio of the readings of the two wattmeters used to measure the power of a three-phase system changes with the power factor and is unity when the power factor is unity, has been made use of by the General Electric Company to indicate the power factor. The instrument is simply two wattmeters of the dynamometer type, the movable coils of which are attached to the same spindle. The instrument deflects to the right or left, according as the current lags or leads, and stands at zero when the system is balanced and the power factor unity.

Ferraris' Power Factor Meter (2*c*).—Ferraris combines two harmonic fields, producing a rotating field of elliptical form. Within this field is suspended a short-circuited coil which can be held in any position, by a torsion spring, as is the movable coil of a Siemens dynamometer. The force required and therefore the angle through which the spring must be turned, to hold the coil in any position is proportional to the square of the intensity of the flux in that direction. Points can thus be determined and the ellipse plotted and the sine of the phase angle deduced as above. (See Puluj's method.)

Power Factor Indicators (3).—In the methods described above, the object sought was the determination of the phase angle. But few of these are applicable under the usual operating conditions. We might mention as useful forms, those of Tuma and the General Electric Company. In most cases, however, we are more concerned with the magnitude of the wattless component of current than with the power factor. We care less about the decrease in the total output than about the poor regulation caused by inductive loads. Instruments which will indicate the wattless current, or rather the wattless volt amperes, are easily made in commercial form.

"Wattless Wattmeters." Dynamometer Type (3*b*).—A Siemens dynamometer becomes a wattmeter indicating $E\ I \cos \phi$ when the current is passed through one coil and a current proportional to and in phase with the e. m. f. through the other.

If the current in the pressure coil be in quadrature with the e. m. f. the instrument indicates $E\ I \sin \phi$, the wattless volt amperes.

This is easily done with a two-phase system. With a single-phase system it is necessary to place a proper condenser or inductive reactance in series with the pressure coil.

"Wattless Wattmeters." Induction Type (3*c*). *Dobrowolski's Power Factor Indicator.*—In a fully compensated induction meter the shunt flux is in quadrature with the series flux, the result of the two being a rotating or shifting field. If the shunt flux be brought into phase with the series flux an alternating field only will be set up as long as the current and e. m. f. are in phase. If, however, the current lags, the field will rotate in one direction. If it leads, the field will rotate in the opposite direction. The torque developed on a disk placed in this field is, in either case proportional to $E\ I \sin \phi$, the wattless volt amperes. This is the principle of Dobrowolski's apparatus.

The movable disk is held in its zero position by a spring when the wattless volt amperes are zero, but deflects one way or the other, when the current is out of phase, an amount proportional to $E\ I \sin \phi$.

Any induction wattmeter can be used in this way provided the flux through the pressure coil be brought into phase with the e. m. f.

Wattless Current Meters (4).—The Allegemeine Electricitats Gesellschaft make an instrument which indicates the wattless current. This is really an induction wattmeter having the shunt flux in phase with the e. m. f. and indicates therefore only when there is a phase difference. As an instrument of this type indicates $E\ I \sin \phi$, it is presumed that this meter is graduated to read $I \sin \phi$ at normal voltage, and should properly come under "wattless wattmeters" (3*c*).

The Siemens Electro-dynamometer.—The paper gives a set of curves which were taken with a Siemens dynamometer, the movable coil of which was in series with a capacity of 3.5 microfads. The values of $\cos \phi$, $\sin \phi$ and $E\ I \sin \phi$ plotted have been computed from ammeter, voltmeter and wattmeter readings given in Table I.

$E\ I \sin \phi$ is a straight line and is plotted above and below the axis to indicate lagging and leading currents, respectively. The base is the deflection in degrees. These curves were taken for a constant power delivered, of 500 true watts. The displacement of current was obtained by means of a phasing transformer. For comparison between $E\ I \sin \phi$ and $\cos \phi$ the axis of abscissæ was taken as unity for the latter, and the decreasing values plotted above and below this.

TABLE I.

SIEMENS DYNAMOMETER AS POWER FACTOR INDICATOR.

Amp. I	Volts E	Watts $EI\cos\phi$	Deflection.	Direction.	Phase.	Apparent watts $E\ I$	Power factors $\cos \phi$	Inductance factors $\sin \phi$	$E\ I \sin \phi$
10.15	108	500	213	Right	Lead	1096	.456	.889	975
8.4	108	500	158	"	"	907	.552	.834	755
7.58	107.9	500	141	"	"	818	.611	.791	647
6.51	108	500	106	"	"	703	.711	.703	494
5.63	107.8	500	78	"	"	607	.823	.568	294
5.25	107.8	500	53	"	"	516	.884	.467	241
4.78	105.5	500	13	Left	Lag	504	.992	.126	63
5.05	105.7	500	44	"	"	533	.938	.346	185
5.67	106.1	500	76	"	"	602	.831	.555	334
8.17	106	500	155	"	"	866	.577	.817	707
9.61	105.9	500	197	"	"	1007	.497	.867	873

NOTE.—Pressure coil in series with 3.5 microfarads capacity.

It is shown that these lines do not pass through the origin. The resistance of the pressure coil is not negligible, as the instrument shows a slight deflection at unity power factor. The curves show very clearly that a slight change in the power factor when near unity caused a comparatively large change in the value of $E\ I \sin \phi$.

This fact is very striking when working with the instrument. It may be made to deflect considerably to the right or left without producing any appreciable change in the reading of the Weston wattmeter, the current and voltage remaining constant the while.

Power factors for larger power delivered, lie below the one just considered and hence are still flatter when approaching unity. One for 1000 true watts has been plotted from calculated values only. It shows that it would be practically impossible to say from ammeter, voltmeter and wattmeter readings alone, when the current was in phase with the e. m. f. With the power factor indicator, however, there would be no difficulty in getting an almost exact adjustment.

Weston Wattmeter as Power Factor Indicator.—The characteristic of a Weston wattmeter of 150 volts, 50 amperes capacity, used on a two-phase system in the manner described above, is given. The characteristic is a straight line, but does not pass through the origin.

This may be due either to the slight inductance of the pressure coil, or to a slight change in the phase angle between the impressed e. m. f.'s, or to both.

The method of calibrating consisted in connecting the pressure coils of the power factor indicator and wattmeter, respectively, to the two primary windings of a two-phase induction motor, used as a phasing transformer. The current coils of the meters were in series and connected to the movable secondary. As the secondary is shifted, the load is partially shifted from one phase of the primary winding to the other. This doubtless caused a slight change in the phase angle between the e. m. f.'s at the motor terminals. The motor used was rated at 2 horse-power. The supply was drawn from two 4-kw transformers, both partially loaded in addition with lights.

TABLE II.

WESTON WATTMETERS AS POWER FACTOR INDICATOR.

True Watts.	Volt-age.	Am-peres.	W'tless volt amperes observed.	Phase relation.	Volt-amperes.	Power factor.	Inductance factor computed.	W'tless volt-amperes computed.
1970	111.5	44.4	4530	Lag	4950	.398	.917	4540
1970	111.5	29.8	2690	"	3340	.590	.807	2690
1970	111.5	20.1	1050	"	2240	.879	.477	1070
1970	111.5	17.7	180	"	1975	.997	.071	140
1970	111.5	17.65	0	—	1970	1.0	.0	0
1970	111.5	20.1	1130	Lead	2240	.879	.477	1070
1970	111.5	29.8	2785	"	3340	.590	.807	269
1970	111.5	44.4	4610	"	4950	.398	.917	4540

The agreement between observed and calculated values of $E\ I$ sin ϕ is good. Table II. gives observed and computed values for this instrument.

NInduction Motors.—The paper shows a set of curves obtained from a Shallenberger integrating wattmeter used as a power factor indicator. The instrument is a 500-volt, 10-ampere meter of the older type (1898). The reactive coil was replaced by a non-inductive resistance of 2000 ohms. In series with this was a capacity of 3 mf., this being found to balance the inductance of the shunt coil at a frequency of 60 cycles. In this case the instrument was used as a recording meter. The curves plotted are $E\ I$ sin ϕ, cos ϕ and ϕ, all on a revolutions-per-minute base, for a delivered power of 500 true watts. Table III. gives the instrumental readings and computed values for these curves.

Table IV. gives results from the same meter under somewhat different conditions. Here the recording train was removed to lessen the friction, and a light steel spring attached to the spindle of the revolving disk. A pointer attached to the disk passed over a scale marked in degrees. The curves plotted are, as before, $E\ I$ sin ϕ, cos ϕ and ϕ, for a delivered power of 500 true watts. The base is degress deflection. It is shown that from 20 degs. lag to 20 degs. lead the deflection is almost directly proportional to the phase angle. The flattening of the curve for cos ϕ is very marked. This instrument was even more sensitive than the dynamometer and besides was dead beat, as the damping magnets were left in. Table IV. gives the instrumental readings and computed values for the curves.

TABLE III.

SHALLENBERGER WATTMETER AS POWER FACTOR INDICATOR.
10 AMPERES, 400 VOLTS.

Amp.	Volts.	Watts	r.p.m.	Direction.	Phase.	Apparent watts $E\ I$	Power factor cos θ	Phase Angle	Inductance. factor sin θ	$E\ I$ sin θ
10.01	111.3	505	30.8	Left	Lagging	1114	.449	63o-10′	.898	996
6	111.5	505	13.45	"	"	669	.756	40—53	.655	438
4.78	110.3	505	4.68	"	"	527	.954	17—26	.300	158
4.5	111.9	505	0	—	—	504	1.00	0	0	0
4.58	114.5	505	5.29	Right	Leading	525	.962	15—50	.273	143
6.09	112.2	505	14.6	"	"	684	.738	42—26	.675	462
10.0	111.2	505	30.6	"	"	1112	.454	63—00	.891	992

NOTE.—Impedance coil cut out and shunt coil in series three microfarads and 2,000 ohms.

Application of Power Factor Indicator.—To illustrate the application of a power factor indicator, the Weston wattmeter mentioned above was used to measure the wattless volt amperes taken by a General Electric 7½-kw, 125-volt, four-pole synchronous converter for different values of field current. The converter was run on a two-phase system at constant input. The supply was drawn from two Westinghouse 7½-kw transformers, both fitted with a Hartford regulator. The output was absorbed by a lamp bank and water rheostat.

Curves were plotted with armature current and wattless volt-amperes as ordinates, the base being field current. The imput was 3½ kilowatts per phase. The flatness of the current curve alluded to above was quite noticeable here. The characteristic for wattless volt amperes was plotted above and below the axis of abscissæ to indicate lagging and leading currents, respectively.

The instruments were quite steady, a condition indicating but little hunting of the armature, although there were no devices on the machine to prevent this phenomenon. The power factor indicator, although exactly like the wattmeter, was even steadier than the latter. There was no difficulty in setting the indicator to read any desired value by adjusting the field current.

It was stated at a recent meeting of the National Electric Light Association, during the discussion of a paper on synchronous converters, that it was practically impossible to operate a synchronous motor or converter at unity power factor. The reasons given were

TABLE IV.

SHALLENBERGER WATTMETER AS POWER FACTOR INDICATOR.

Amp-eres.	Volts.	True watts	De-grees deflec-tion.	Direc-tion.	Phase.	Appar-ent watts.	cos ϕ	ϕ	sin ϕ	$E\ I$ sin ϕ
8.29	110.	500	75°	Left	Lag	911	.549	56°—42′	.836	761
6.54	109.	500	50	"	"	712	.702	45—35	.712	507
5.41	109.2	500	30	"	"	590	.848	32—00	.530	313
4.94	109.9	500	20	"	"	543	.921	22—56	.390	212
4.57	111.1	500	10	"	"	507	.987	9—04	.158	80
4.59	108.4	500	0	—	—	498	1.	0	0	0
4.67	109.	500	10	Right	Lead	509	.982	10—53	.189	96
5.35	108.	500	30	"	"	578	.865	30—07	.502	290
6.45	109.7	500	50	"	"	707	.708	45—05	.706	498
8.16	108.7	500	70	"	"	886	.564	55—40	.826	732

NOTE.—Impedance coal removed and shunt coil in series with three microfarads and 2000 ohms non-inductive resistance. Recording gear removed and light torsion spring attached to disk.

hunting of the armature and dissimilar e. m. f. waves of motor and generator. In the above experiment it was found that the power factor indicator could be set at zero and under these conditions the true watts and the volt amperes were equal. This condition would seem to be that of practically unity power factor.

A number of power factor curves of synchronous converters have been published recently, in which the current passes from lag to lead without the power factor passing through unity. Even if it were impossible to hold the power factor at unity, it must pass through this value as it swings across the line.

In Table V. are given the data which were obtained in a test, power factor being from wattmeter readings and inductance factor from the "wattless wattmeter" readings. In addition there were plotted two curves obtained by assuming these values to be cosines and sines of phase angles and the corresponding values of sines and cosines taken from tables and plotted on the same base. These deduced values do not agree at all with the observed ones. The discrepancy is greater for leading than lagging currents. This discrepancy, as has been pointed out by Mr. Steinmetz, is due to the distortion of the e. m. f. and current waves.

Conclusions.—It would seem from the above that there is a decided need of an accurate power factor indicator in all large installations,

TABLE V.

GENERAL ELECTRIC SYNCHRONOUS CONVERTER. 7½-KW, 125-VOLT, FOUR-POLE, 60 ~, TWO-PHASE. INPUT 3.5 KILOWATTS PER PHASE.

Wattless kilo-volt amperes	Amp-eres ar-mature current	Voltage at brushes	Amp-eres field current	Phase rela-tion.	Kilo-volt am-peres.	Power factor	Induc-tance factor □ ▭	sin computed from power factor.	cos computed from induct-ance factor.
5.55	61.6	109.9	0.57	Lag	6.76	.518	.822	.855	.569
2.62	40.9	109.9	1.03	"	4.5	.778	.583	.628	.812
0.45	32.0	109.8	1.36	"	3.51	.997	.128	.077	.992
—0.05	31.9	109.8	1.47	Lead	3.50	1.0	.014	.0	.999
—0.45	32.1	110.0	1.55	"	3.53	.992	.128	.126	.992
—1.20	35.7	110.4	1.69	"	3.94	.888	.306	.460	.952
—3.65	51.3	110.0	2.22	"	5.64	.621	.648	.784	.762
—6.65	71.9	100.8	2.75	"	7.89	.444	.844	.896	.536

but especially in those in which induction and synchronous motors are used together. This method of operation has been adopted by the Deering Harvester Company, where adjustment of the exciting current of the synchronous machine is made by means of a wattmeter, and at Butte, Mont., where adjustment is made from ammeter readings. The advisability of adopting this composite system is not in question here. We are considering merely the best method of attaining the end sought. For accurate adjusting of the system the indications of the instrument should depend upon the values of ϕ or sin ϕ and not upon cos ϕ.

Instruments of the dynamometer or the induction type seem more

suitable for operating conditions. If the meter be of the dynamometer type the resistance of the pressure coil must be negligible if it is to be used on a single-phase system, as the current in this coil must be in quadrature with the e. m. f.

If the meter is to be used on a two or three-phase system, the inductance of the pressure coil must be negligibly small, and meter connected in one of the methods described above. In this case care must be taken that the loads on the different phases be kept equal. In a two-phase system, unbalancing the phases will shift the e. m. f.'s relatively to each other. In a three-phase system, since the meters used are really wattmeters, unbalancing the phases will vitiate the indications of the instrument.

If the meter be of the induction type the inductance of the pressure coil must be negligible, since not only is it undesirable to use condensers to compensate for this, both from their bulkiness and expense, but the presence of any reactance makes the deflection dependent upon the frequency. An attempt was made to improve upon the induction meter described above by removing the three-legged stampings of iron upon which the pressure coil was wound. The inductance was still too large for satisfactory working, and as the condensers in the laboratory were not sufficient to compensate for this, it was necessary, to make up for this lack of capacity and to avoid the use of iron, to add an auxiliary inductance wound on a wooden bobbin. The instrument thus modified was found to be so sensitive to slight changes in frequency that it was impossible to use it with any degree of satisfaction in the laboratory. Any change of load on the prime mover would so change the reading of the instrument as to make its indications extremely unreliable.

Dobrowolski shows, in the reference given above, the application of his instrument for automatically adjusting the excitation of the synchronous machine so as to keep the power factor at unity at all times.

The use of an instrument of this kind emphasizes the fact that, when induction motors are used alone, the inductance factor is always a large percentage of the power factor. For instance, when the power factor is .85 the inductance factor, assuming sinusoidal waves, is nearly 62 per cent of this. That is, for every 1000 watts used by the motor, 620 "wattless watts" are, so to speak, borrowed. It would seem but fair that those who used induction motors should at least pay rental for the wattless volt amperes required. It is true this does not represent energy consumed, but it does, in a sense, represent energy borrowed and returned and the station must have sufficient capacity in generators to meet all such calls for loans.

The additional charge could be taken care of by over-compensating integrating wattmeters of the induction type, as suggested by Mr. Benischke. They would then read high on lagging reactive loads and low on leading reactive loads. This would put a premium on the use of synchronous motors as they, if not too greatly over-excited, help out in the regulation of the plant. The induction motor has so many points in its favor it can well afford to pay for what it needs—a large wattless component of current.

A Note on English Methods.

BY E. KILBURN SCOTT.

ONE result of the recent visit to Germany of the British Institution of Electrical Engineers is that it makes the younger English engineers more and more dissatisfied with the state of the electrical industry at home. A grave fault with all British electrical engineering is that it has throughout been of too tinkering a character, and this is partly traceable to the training of the men who have until recently, at any rate, taken leading positions in the electrical profession in England. The telegraphic and telephone men, inventors (or royalty mongers), wiring contractors, etc., are very good in their place, but as engineers in the broad sense they are undoubtedly not a success, and this is well known on the continent. However friendly on the surface, there is no doubt that the highly technical German expert looks upon the partly trained telegraphist or commercial man posing as an electrical engineer as the fraud he really is.

One thing is very evident, and that is that the purely English manufacturer must knock off making dynamo machinery, etc., and let some one else do it for him. This, as a matter of fact, is what is happening, in that various firms from abroad are establishing works in England to do that which the home firms should have done long ago. The average tinkering, tinpot, copper alternator and two-pole dynamo makers, especially those employing as dynamo designers students who hardly know a pump from a mangle, are going to get badly left, and they deserve it. Another individual who will have to go is the one-horse template pattern consulting engineer, the man who for lighting a town advises and lays down a 60-kw generator or some equally absurd small unit. Then there is the man can't advise his client to run a works by polyphase motors because such motors "are so inefficient," when any one can see that the real reason is because he knows absolutely nothing about the subject. Finally, there is the funky-monkey commercial man, who figures, so largely on the directorates of English limited companies—he also won't be missed.

Some few years ago a well-known Glasgow gentleman made a semi-official visit of inspection round the leading iron and steel works of the States. On his return he stated very impartially the position of affairs, but the British ironmasters were critical and said money was not being made in actual manufacturing, etc. Yet it came out later in the lawsuit between Carnegie and Frick that the former had been taking millions a year out of the business in manufacturing profits alone.

As it was with the steel trade, so it is with the electrical industry. When the pottering English manufacurer sees or is told of the fine works abroad, he promptly says that they are not working at a profit. He states in so many words that the money is being supplied by banks for the pure love of squandering it, totally ignoring the fact that banks abroad are conducted on practically the same commercial lines as in England, and they don't carry on business purely for the love of it any more than Carnegie or his partners.

The writer thinks he can detect a tendency in the English manufacturer to pat himself on the back and say, "T. G., we are not as other men (the Germans and Americans) are. We may be behind in our design and methods of manufactures, but, at any rate, our finance is all right." But such as are of this way of thinking will make a grand mistake if they carry on their stick-in-the-mud policy any longer. Although they may be busy for the time being, there is no doubt about it that the continental firms are preparing to rush plants into England at prices which the badly equipped English works cannot reach by 15 or 30 per cent; and, further, English buyers are every day getting more and more confidence in machinery designed or made abroad as has been shown recently in a most striking manner.

At present it is the fashion to blame the English working man, his unions, the growth of the municipal idea—in fact, anything but the main reason, which is the woeful ignorance or supineness of those who are supposed to lead in the English electrical profession. The American firms got into the English market in the first instance by supplying alternating-current machinery which could be depended on to work continuously without break-down. When traction work came along, what was easier than that some established English firm should take an American traction motor and build some like it. One or two did essay the task, but they made such an awful mess of it, that it was not until an American firm was established in the country that reliable home-made car motors could be bought.

Foreign firms are now taking the cream of the orders—that is to say, all the big contracts—simply because no home firm has designers or the plant to execute such work. Eighteen firms quoted to Manchester the other day for a £140,000 order, and of these 15 were foreign, and it was given to a Berlin firm. A Frankfort firm, Lahmeyer & Co., got the two Charing Cross & Strand orders, totaling £350,000, and the many contracts secured by American firms are too well known to need recital.

It might be thought that these strictures are too severe, but those who have a thorough inside knowledge will recognize their truth. If there were anything to applaud the English manufacturers for, the writer would be the first to do it. At present, however, they only want a whipping for being such incompetent messers.

The Gender of "Automobile."

This question of gender is a vexing problem to French grammarians. Many writers make it feminine. Emile Faguet is among them. But the *Auto-Velo* reproached him for defying the academy, which is said to have voted for the masculine. Faguet then wanted to know why the Academy made "automobile" masculine, at the same time that it made "locomobile" feminine. "Why," was the reply, "an automobile is clearly too ugly to be feminine."

Magnesium Carbide.

The recent announcement of a method for the production of carbide of magnesium by direct reduction recalls the interesting part which this body played in the early history of the carbide art. The existence of a compound having the formula MgC_2 was known, and it was readily calculated from considerations of atomic weights, that a carbide of the above composition should, by reduction with water, yield an amount of acetylene gas large exceeding, per unit weight of carbide, the quantity obtainable from the calcium compound. Thus 1 lb. of calcium carbide liberates, according to theory, .406 lb. of acetylene, or at 60 degs. F. and 30 inches barometric pressure, 5.93 cubic feet, whereas the reaction—

$$MgC_2 + 2\,H_2O = Mg\,(OH)_2 + C_2H_2.$$

indicates .591 lb., or 8.63 cubic feet of acetylene for each pound of magnesium carbide, an excess of nearly 50 per cent. It seemed a fair assumption that methods capable of yielding calcium carbide would prove effective for the magnesium compound, and indeed Borchers had announced with all the emphasis of spaced type that given a sufficient temperature every metallic oxide was reducible by carbon. Accordingly, we find that Willson in his early foreign patents specified dolomite (the double carbonate of calcium and magnesium), as a raw material of peculiar value for carbide manufacture, and Dr. Cabell Whitehead, of Washington, even obtained a patent in 1896 describing and claiming as a new chemical compound a crystalline double carbide of these metals, obtained, it was said, by electric furnace reduction of calcined dolomite. At this time the prediction was freely offered that the development of the future would occur in the line of the magnesium compounds rather than with those of calcium.

Just at this juncture, however, Moissan, in steady pursuit of his splendid researches upon the properties of the carbides, published the simple statement that magnesia is irreducible by carbon even at its temperatue of fusion. This conclusion was quickly confirmed by Morehead and De Chalmot. The refractory character of this single oxide was entirely unexpected in view of its near group affiliation to metals readily reducible, and the discovery effectually disposed of the claims which had been put forward by Borchers to priority of the discovery of calcium carbide upon the narrow basis of a generic statement, now proved to be inaccurate. The fact as now known, is that the presence of magnesia even in small amount is peculiarly detrimental to the manufacture of calcium carbide, and dolomitic limestones are unsuitable for this purpose. If magnesia be present, even to the extent of 2 per cent in the mixture, the diminution of yield is marked, the falling off being apparently due to the physical effect of the inert oxide becoming interposed between the carbon and the lime and thereby preventing their reaction.

In this inertness to carbon at all temperatures magnesium oxide seems to be unique, but the property has proved of value in electric furnace construction since it permits of the reaction chamber being formed with walls in which bricks of magnesia and carbon alternate. Moissan seems to have at first attributed this peculiar property of magnesia to the fact, long ago noted by Ditte and confirmed by Moissan for the hightest temperatures, that the oxide polymerizes rapidly with rise of temperature, the specific gravity increasing regularly from 3.19 in the case of oxide, which has been heated to 350 C., to 3.65 for magnesia solidified from full fusion. Later, however, he found the simple explanation in the fact that magnesium carbide is quite unstable even at temperatures now considered moderate. It is completely decomposed by the heat developed by a current of 600 amperes at 60 volts, and at the temperature of fusion of magnesia is entirely incapable of existence.

It follows, of course, that any process for the production of magnesium carbide must operate at relatively low temperature. The new method, which is due to Mr. Henry Spencer Blackmore, and forms the subject of a patent issued Aug. 20, secures a low reaction temperature by the use of a flux of haloid compounds of the alkali metals, and utilizes as a reducing agent, calcium carbides. In carrying out the invention, sodium and potassium fluorides in proportion to yield a readily fusible bath are melted, and magnesium fluoride and calcium carbide are introduced; the reaction whereby magnesium carbide and calcium fluoride are formed is as follows:

$$MgF_2 + CaC_2 = MgC_2 + CaF_2.$$

Of course, commercially considered, this reaction is a costly one, and even though magnesium carbide were produced to the full extent indicated by theory, the cost of acetylene would hardly thereby be cheapened. As to the actual efficiency of the method and the form in which the carbide separates, we are as yet, unfortunately, entirely in the dark.

Danger to Firemen from Electrical Wires.

Mr. Morris M. Mead presented a paper this week before the meeting of the International Association of Fire Chiefs at Indianapolis on the danger to life attending firemen when at work fighting fires by electric light and trolley wires, and the remedy. After an interesting and intelligent discussion of the subject, Mr. Mead said:

In enumerating and closing, I would place, first, a thorough municipal control—under one head—of all municipal electrical matters, backed up by a legislative power to compel compliance to reasonable suggestions in a reasonable way.

Secondly, I would compel all overhead wires to be placed underground, especially electrical light and power wires, carrying 300 volts and over, in the business parts of all cities and towns and along all main avenues leading to the outlying districts of the city. I would compel all feed wires to be placed underground for railroad purposes, and wherever the local conditions warrant, to place the underground system in use.

Next, I would compel an overhead construction (where the wires were not underground), and all circuits be run parallel or side by side, at intervals of every 2000 or 3000 ft., lead off to properly protected and covered double pole, switch cut-outs. That the voltage of every circuit be marked upon each circuit and located at regular intervals. Next, that these locations, as well as the location of every circuit on each pole, be carefully mapped and blue printed, and copies left at the fire chief's headquarters and at the headquarters of the municipal electrician. That the men be carefully drilled as to the location of these cut-outs and circuits, and in the proper methods of handling the same. That one or two men, competent electricians, be detailed to go to all fires; that the companies, both lighting and railroad companies, be compelled to have special wagons and outfits controlled by competent men placed at regular intervals. through the business parts and built-up sections of the city, that they have gong attachments and all necessary communication features with the Fire Department proper; that they answer every alarm, and that the men be compelled to sleep at these several locations, or that a duplicate force of competent men should be employed.

Next, that reasonable precautions to safety be furnished each fireman, by way of ruber boots and rubber gloves, and insulated temporary tools to handle himself with, to be used in all cases of necessity.

Independent Telephone Development.

The Consolidated Telephone Company and the Inter-Ocean Telephone Company, recently formed in Cleveland, Ohio, to build lines and exchanges in New York State, have opened a fine suite of offices occupying half the second floor of the Electric Building, in that city. The officers of the new companies have already been referred to in these columns. The accounting department of the companies has opened for business under the management of Mr. R. E. Glass, who is recognized as one of the most expert accountants in Ohio. Last week the Consolidated Company took over the independent plant at Ithaca, N. Y. The Ithaca plant will be equipped with a new board and central energy system, and proposes to furnish the best of service at $36 and $24 rates. During the past week the Inter-Ocean Company closed important exclusive toll line contracts in New York State. The Corning exchange of the Consolidated Company has been cut in with 150 subscribers, and 650 three-year contracts waiting to be connected up. The Consolidated Company owns and controls the plants operating at Ithaca, Hornellsville, Corning, Wellsville, and other New York towns, and has in process of construction plants at Elmira, Waverley, Sayre, Athens, Watkins and Bath, with approximately 80 miles of long-distance line connecting Elmira and Wellsville and other intermediate cities. It has important franchises and toll line rights of way and contracts for long-distance service in Allegany, Steuben, Schuyler, Chemung, Tompkins and Tioga counties, New York.

Tesla Patents.

As noted in our issue of last week, two decisions have lately been handed down sustaining the Tesla patents, one from the United States Circuit Court of the Southern District of New York, and another from the United States Circuit Court of Appeals for the Second Circuit.

The first-mentioned decision was by Judge Lacombe. The defendant's device is an alternating-current wattmeter, and it was contended by the complainant that the circuit to which the meter is connected is divided so that part passes through a fine wire coil and another part through a coarse wire coil, and that as a consequence there is a difference in phase between such circuits. The complainant contended that this arrangement is an infringement of two Tesla split-phase patents, both bearing date of Dec. 26, 1893.

The defendant contended that the device does not constitute an infringement for two reasons, that the patents at issue cover motors only, while the device in suit is a meter. In the opinion of the court, this is a mere verbal distinction without apparent merit. The patents contemplate the production of power, though they are wholly silent as to the amount of power. The meter exerts power, its disk rotates against the action of a permanent magnet and turns a spindle which operates the registering devices. Second, the defendant contended that the meter does not operate by virtue of the so-called "Tesla rotating field" of the polyphase patents. The court considers that the preponderance of evidence indicates that in the motor in suit there are independent energizing circuits; that alternating-current from a supply circuit is passed through both, and that by a variation or modification of the relative resistance or self-induction of these energizing circuits they are put into different phase; and that the revolvable disk becomes effectively operative because such arrangement exerts its influence through the development of a rotating field, which is characteristic of Tesla methods.

The conclusion of the court is that the motor involved an infringement of the claims of both the Tesla patents above mentioned.

The second decision is by Judge Shipman, and was on an appeal from the Circuit Court of the District of Connecticut in the suit of the Westinghouse Electric Manufacturing Company against the New England Granite Company. The Circuit Court opinion of Judge Townsend was printed in our issue of Sept. 8, 1900.

The opinion of Judge Shipman is lengthy, and quotes largely from that of Judge Townsend, which it sustains. Taking up the main points of the defense, it is noted that Bailey said that the object of his experiments was to cause a disk to rotate by an intermittent rotation of the field, effected by electromagnets, and this statement is sufficient to show that he neither thought of nor unconsciously aided in solving the problem of transmission of power by electric currents of any kind. Bailey, in his experiments with reversed currents did not attempt to produce, as Tesla did, a continuously rotating field. Reverse currents and alternating currents, though they may be equivalents for some purposes, are not equivalents for transmission of power over a distance. Reverse currents cannot practically be used for that purpose.

Taking up the Bradley defense, it is stated that Bradley's alleged invention was a dynamo "which would generate an alternating or a continuous current as desired." He described two currents obtained from the same machine, and says that they can be employed for any purpose for which alternating currents are applicable, and they may be used separately, one being employed to feed one circuit and the other to feed another circuit, but he apparently did not in his application understand any benefit resulting from the transmission of two currents of different phase.

Judge Townsend is quoted to the effect that Bradley's application is limited in scope, ambiguous and indefinite. It fails to show that he had any conception of the Tesla idea of "the utilization of the motor for the purpose of progressively shifting the magnetic poles of a plurality of alternating-currents by circuits which preserve the independence and differing time relation of the other phases." Even if the idea had been first conceived by Bradley it was not sufficiently described to disclose a principle or method of operation. Bradley does not anticipate or limit this principle, Tesla being the first to reduce it to practice.

As to the Marcel Deprez defense, what Deprez did was to mathematically demonstrate that the polar line of an annular magnet may be shifted the entire circumference of the ring by two magnetizing forces properly related; he showed how a resultant magnetic field could be produced, but he did not describe or suggest apparatus for power. His currents were not the alternating currents of Tesla. Giving the Deprez theorem all the value to which it is entitled, its application by Tesla to the production of a new, original and most beneficial practical result by new and described means and the use of polyphase alternating currents; in brief, by the polyphase system —the apparatus of Tesla nevertheless was an invention of a very high order.

Referring to the Siemens patent of August, 1878, it is stated that the drawings showed direct-current machines and those capable of being both direct and alternating. The part of the specifications upon which the defendants lay stress is as follows: "It is to be understood as stated above that with suitable modifications these apparatus are generally applicable also as rotary transmitting machines, the rotary parts being caused to revolve and give out mechanical power when electricity is applied to them, and thus one of these machines may be driven by any suitable motive power so as to generate electricity, and this electricity may be conducted to a similar machine at a distance, causing it to work and to give out a portion of the power applied in the first instance." The opinion states that no modifications are described, and there is no suggestion that the patentee thought of such connections between the generator and motor, each of two phases, as to preserve the phases of the two and the difference of phase, and that currents should act independently and regularly succeed each other and thereby keep the armature constantly rotated. The hints in the patent respecting the modifications by which the apparatus could be made to give out mechanical power were valueless, as no modifications are described, the kind of apparatus to be modified is uncertain and independence of phase was not in contemplation by the patentee.

As to the claim that the reversibility of the Siemens or Bradley apparatus followed from a principle universally recognized as to the reversibility of electric machines, it is stated that the reversible principle, while true in regard to direct-current machines, was only a matter of theory and not of practice in regard to alternating-current motors for power purposes. Declarations that such machines could be so reversed so as to furnish power were merely theoretical and gave no information to the inventor of the method by which reversibility was to be made useful to accomplish any result.

As to the point that infringement of the patents in suit is limited to synchronous motors and thereby not infringed by the defendant's induction motor, the opinion says that assuming the patents did describe synchronous motors only, their claims did not make and did not intend to make synchronism a part of either patent, but were for the broadly described invention of "a novel system of electric distribution and transmission of power by means of alternating currents."

Electrical Development in Greece.

Mr. F. W. Jackson, United States Consul at Patras, Greece, writes as follows:

The progress of communication within Greece at present is marked, and promises in the near future to bring conveniences of travel to a level with those of any country in Europe. The Greek Electric Company, otherwise known as the Thomson-Houston Company, established in 1898, with a capital stock of 10,000,000 drachmas ($1,250,000), of which 5,000,000 drachmas ($625,000) is paid up, is now completing in Patras the first electric street railway in Greece. The same company operates the gas company of Patras, the electric-light plants of Athens and Piræus, and of four or more other cities, and is now negotiating with the Athens-Piræus Street Railway Company to supply motive power from a central electric station at Phalerum, near Athens. This proposed power station, if constructed, will be on a scale sufficiently large to supply power for manufacturing purposes, as well as for the lighting of Athens, Piræus and Phalerum.

Speaking more particularly of the street railway in Patras, the system will be similar to that found in general use in France and Italy. The motive power will be furnished by gas engines of German construction. The steel rails are from Belgium, while from the United States there will come—from the General Electric Company—the material for the aerial line, insulators and car motors, and—from the Brill Company—the trucks for the cars. The main stem of the road is constructed the length of the city, parallel with the sea, and extends some distance beyond the city limits, to a point suitable for coffee houses and baths.

CURRENT NEWS AND NOTES.

"WIRELESSING" is the word we find in the New York *Herald*, used to describe the act of sending a message by wireless telegraphy.

BRITISH TELEGRAPHS.—The British Postmaster-General has just issued his report for 1900. The telegraph department again shows a big deficit, being this year $3,260,500.

THE NEW YORK CENTRAL has had notice served on it by the New York Board of Health to stop the smoke nuisance in the terminal tunnel. As stated in these pages last week, the company has already placed the matter in competent engineering hands.

RONTGEN SOCIETY.—The second regular meeting of the Röntgen Society of the United States will be held at Buffalo, N. Y., Sept. 10 and 11. A programme of papers has been prepared to cover a great variety of subjects of special interest to the members. Room will be provided for the exhibition of apparatus and accessories, and every possible aid to demonstration will be given.

THE PROPOSED AMERICAN PACIFIC CABLE.—United States Consul General Rublee at Hong Kong reports that the business community in that city is taking a keen interest in the proposed cable between the United States and Manila, and its eventual connection with Hong Kong. The present rates are regarded as excessive, and it is thought that the American cable would afford relief in this respect. The project has been indorsed by the Hong Kong Chamber of Commerce.

FRENCH AUTOMOBILISM.—The Czar of Russia is to visit France to witness the autumn grand manœuvres, and it is stated that automobiles are destined to play a great part in the manœuvres, notably in reconnoitring and in the transmission of orders. General Brugere, generalissimo of the French army, already has at his disposal a swift 24-hp Gardiner-Serpollet automobile, which will be driven by one of his staff officers. This automobile has been sent to La Rochelle to meet General Brugere. Numerous other machines are to be employed by the chief officers.

G. A. R.—The Consolidated Telephone Company, the Inter-Ocean Telephone & Telegraph Company, and the Century Telephone Construction Company, all of Cleveland, Ohio, have issued the following notice: "We wish to extend a very urgent invitation to the members of the Grand Army of the Republic and their friends who may be interested in the telephone business, and who intend to visit Cleveland during the Grand Army encampment on Sept. 9, to make our offices on the second floor of the Electric Building their headquarters. We shall take pleasure in taking care of their mail, furnishing all the information in our power and making their visit agreeable in every way."

ALASKA CABLE.—The steamship "Lakme" sailed from Seattle, Wash., for Skagway, Alaska, on Aug. 15, with the Alaska cable expedition, headed by Mr. G. F. Porter, of the Brixey Kerite Company. The Government cable, which will extend from Skagway to Juneau, is in one section, 126 miles in length. A party of 10 students from the University of Washington accompanied the expedition to assist in the work. One of their number was Miss Pearlita C. Stadelmann, who is taking the course in electrical engineering. The contract price is $75,000, and the actual work of laying the cable should be accomplished in about 26 hours. Major W. A. Glassford represents the signal service of the army in the work.

A. A. A. S.—The American Association for the Advancement of Science, in session in Denver, has installed these new officers: President, Professor Charles S. Minot, of Boston; vice-presidents, Section A (mathematics and astronomy), James McMahon, of Cornell University; Section D (mechanical science and engineering), H. S. Jacoby, of Cornell University; Section G (botany), B. T. Galloway, of the United States Department of Agriculture; Section H (anthropology), J. Walter Fewkes of the Bureau of American Ethnology; Section I (social and economical science), John Hyde, of the United States Department of Agriculture; permanent secretary, L. O. Howard, of the United States Department of Agriculture; general secretary, William Hallock, of Columbia University; secretary of the Council, D. T. MacDougal, of the New York Botanical Gardens; treasurer, R. S. Woodward, of Columbia University.

MOTOR CONDENSERS.—In the course of a discussion at the recent convention of the Ohio Electric Light Association one of the speakers said that the condenser is likely in the future to occupy a prominent place in the field of electrical distribution. The cost of a condenser for use with motors was stated not to exceed at the present time $10 per kilowatt. With motors whose highest power factor is above 90 per cent the condenser capacity required is only about 10 per cent of the capacity of the motor, thus bringing the expense within very reasonable limits. Commenting on this statement another speaker said that if condensers were used with single-phase motors they usually required in addition the introduction of a boosting transformer or compensator, and these two devices will cost about three-fourths as much as the motor. In reply it was stated that a condenser is no more essentially a part of a single-phase motor than of a polyphase motor.

NERNST LAMP HEATER.—A resistance heater for electrolytic incandescent lamps is the subject of a patent granted Aug. 27 to James Swinburne, of Westminster, Eng. Resistance heaters can be made of carbon or metallic conductor mixed with clay, but when the conducting material oxidizes in air at the temperature necessary for a heater, the resistance is greatly altered and can be no longer used as a heater. To overcome this difficulty the patent describes a means of protecting the oxidizable conductor against the action of the air by vitrifying or glazing the insulating material. Graphite is kneaded up with kaolin and squirted into the form of thin rods or spirals, which are then dried and baked at such a high temperature that the kaolin is vitrified. To facilitate vitrification feldspar may be added to the kaolin, or the kind of clay used for china may be employed instead of kaolin and feldspar. Instead of vitrifying the resistance heater it may be glazed by dipping it after it has been fired, into water containing glaze and then firing it in the usual way, such glazes being employed as are soluble in water, such as boracic acid.

PRIMARY BATTERY DIAPHRAGM.—A patent granted Aug. 27 to John Laskey Dobell, of Harlesden, England, relates to the manufacture of diaphragms or porous pots for use in primary batteries in which litharge and caustic soda are maintained in a state of fusion, and acting to produce electricity in conjunction with fused lead and carbonaceous material in which the porous pot is immersed. In practice it is found that a porous pot of the ordinary kind is incapable of resisting the fused oxides, and the objects of the invention is to provide a pot which will effectually resist this deleterious action. Calcined magnesite is moistened with a saturated solution of boracic acid and the mass then kneaded into a stiff paste, after which it is shaped into the form of a porous pot. After being dried and fired the pot is ready for use. As water dissolves a comparatively small quantity of boracic acid, this quantity may be increased by the addition of a suitable amount of the saturated solution of boracic acid in spirits. In cases where it is desired to increase the porosity of the magnesite pot, a quantity of sawdust, bran or other similar material may be mixed with the magnesite.

MUNICIPAL OWNERSHIP IN TOLEDO, OHIO.—After 10 years of experience, Toledo, Ohio, has leased its municipal natural gas plant to a private corporation. This plant has cost the people of Toledo over a million dollars in bonds and half a million dollars more in interest, while it is found now that the rental will be much less than the city will need to keep up the annual interest on the debt incurred when the experiment was undertaken. The Council has leased what was left of the plant to the Toledo Gas Light & Coke Company for a term of 20 years at $6,500 a year. The annual interest account on natural gas bonds outstanding is $47,250. And the city will keep on paying that for many years to come. The cause of the failure is fairly well outlined in this remark by the Toledo *Bee:* "Incidentally, many of the men who shouted loudest for the gas plant got their start in life out of their connection with it, and having become taxpayers, managed to bob up and help urge the Council to lease the plant to a private corporation—so as to save them taxes." Toledo is the home of Mayor Jones, who has been one of the most vociferous advocates of municipal ownership.

ALASKAN CABLE.—The cable between St. Michael, Alaska, and Nome City is broken beyond repair.

MUNICIPAL ELECTRICIANS.—We are informed by Mr. Morris Mead that President McKinley will receive the Municipal Electricians' Association at the International Hotel, Niagara Falls, on Thursday, Sept. 5, and that Friday will be Municipal Electricians' Day at the Pan-American.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION.—The next annual meeting of the Kentucky Independent Telephone Association will be held at Owensboro on Oct. 8 and 9. The Association is composed of about 60 independent companies, and a large meeting is expected.

AUTOMOBILE ENDURANCE TEST.—Up to Tuesday evening there were nearly 80 separate entries for the 500-mile endurance run from New York to Buffalo, of the Automobile Club of America. The start will be made from the clubhouse, the Plaza and West Fifty-eighth Street, at 8 a. m. on Monday, Sept. 9. At present no electric vehicles are entered.

WIRELESS TELEGRAPHY IN CANADA.—It is understood that the Dominion Government will shortly be asked to cause the installation of a wireless telegraph station near Victoria, British Columbia, for the purpose of signaling incoming steamers. The Canadian Pacific officials have made an offer to install the Marconi system on each of their three Empress steamers if the Government will erect a shore station for communication.

AMERICAN FIRE WASTE.—The summary of the fire waste in the United States during 1900, as given in *Chronicle Fire Tables,* shows 109,092 fires in the United States, against 105,342 in 1899 and 94,062 in 1898. Dwellings and boarding houses constituted 46.2 per cent of the property burned. The losses by exposure were 27.6 per cent of the whole. The principal causes of fires in 1900 in the order named (excluding those of unknown origin) were: Incendiarism, defective flues, sparks, spontaneous combustion, electric lights and wires, furnaces, lightning and friction in machinery.

TO ELEVATE THE KING.—The three American electric elevators for Buckingham Palace will have their cabinet work built in England. Of these three elevators one will be for the personal use of His Majesty. A simple press of the button at any floor will bring the lift to that floor, where it will automatically stop and open its doors. By pressing one of a series of numbered buttons inside the car it ascends or descends to the floor corresponding to the number of the button pressed. The elevators are made automatic, so that King Edward, if he wishes, can operate them himself. It is believed that the cost of the three will be about $25,000.

ELECTRICAL ILLUMINATIONS FOR ROYAL VISITORS.—The Dominion Government has decided that the illumination of the Parliament Building, during the visit of the royal party at Ottawa, shall be the finest electrical exhibit, in comparison to the size that has been seen on this continent. Acting in concert with the contractors the Deputy Minister of Marine has secured designs of the Buffalo illuminations, and the plans, now being worked out, are adaptations of these illuminations. The great buildings will be illumined, not from the prominent lines, but from the recesses. The electric light will shine out from the darkest points into the night. All the windows are being picked out in this way, and the cornices over arches, etc., while the big central tower will be framed in electric lights in somewhat the same manner as the great electrical tower at the Pan-American Exhibition. Preparations are also being made to illuminate the new interprovincial bridge in the same manner, the decorations of which will be elaborate and costly. Almost without exception, the larger business buildings, public institutions, railway stations, as well as private residences, will be illuminated with electric light. Already large contracts have been placed with three of the leading electric companies of the city whose capacity will be taxed to the utmost. It is estimated that not less than 100,000 additional incandescent lights will be utilized throughout the city.

MORE LARGE WATER POWER DEVELOPMENT IN SOUTHERN CALIFORNIA.—The increasing production of fuel oil in California does not seem to be preventing the building of more large water power plants for electric transmission purposes, and that, too, right in the midst of the oil-producing region. The Edison Electric Company, of Los Angeles, which has a local distribution at Los Angeles and an 83-mile transmission plant from the Santa Ana Cañon to Los Angeles (see ELECTRICAL WORLD AND ENGINEER, June 29, 1901), and which also now controls a number of smaller companies operating in the numerous small towns between San Bernardino and Los Angeles, has now secured sites in the Kern River Cañon over the mountains north from San Bernardino, and is building a 15,000-hp plant. The plant will be just above that of the Power Development Company, which supplies power to Bakersfield and vicinity for irrigation pumping, as described in the ELECTRICAL WORLD AND ENGINEER of April 6, 1901. The water will be conducted for 8 miles, and will be at a head of 840 ft. at the power house. To those familiar with the country the daring of the scheme appeals forcibly. Two formidable mountain ranges intervene between the company's territory in the Los Angeles region, and the distance air line is over 100 miles. Fuel oil is now obtainable at very low rates at Los Angeles, and Bakersfield is the most important oil-producing center in the State. It certainly appears as if the financial results from long-distance transmission from water powers in Southern California had been very satisfactory when a company already in the business is carrying out such important new projects.

OPEN VERSUS ENCLOSED-ARC LAMPS.—In a discussion at the recent meeting of the Ohio Electric Light Association on the enclosed-arc lamp, Mr. Alexander Dow, in referring to a criticism of the open arc, said that as a basis of comparison the open-arc lamp had been taken as it had been neglected by the ordinary station, while in considering the enclosed arc the newest device with all the latest improvements had been considered. While admitting that the defective open arc with which comparison was made represents current practice much more accurately than is creditable to the industry, yet he wished to say to those members who feel bound to use their open arcs for some time to come, that if they will use first-class carbon, employ screens to keep out wind, dust and insects from the globes, use alabaster plated globes and keep the feed mechanism of the lamps clean and in adjustment, open arcs will give just as good a light as is possible with the best type of enclosed arcs, and will be under no disadvantage except that it will cost more for carbons and for labor and trimming. Against that extra cost of operation may be set the fact that the station will not have to make an investment in new apparatus and thereby increase its fixed charges. In reply to a question as to what he would advise in a case where the management was considering a change to the enclosed arc system, Mr. Dow said that if money was to be had at a reasonable figure and the transaction showed a profit by reason of the increased economy of operation, he would make the change. On the other hand, if money was not to be had easily and cheaply, he would recommend letting the operating expenses stay at the present figures, or even run them up by using better carbons, etc., holding on in the meantime to the old apparatus. It was merely a question in his opinion of finance, not a question at all of giving good street lighting, as this can be obtained with either system. The speaker against whom Mr. Dow's criticism applied said it was perfectly true that the use of an opal globe with an open arc light will improve distribution of the light; that, in fact, if the regulation does not vary beyond, say, two volts, the distribution will be equally as good as from the enclosed arc. Unfortunately, however, the ordinary open arcs in service vary so greatly in voltage that the rise and fall in the light is very objectionable; and while the use of opal globes improves the distribution, it does not in any case bring the steadiness up to the plane of the enclosed-arc lamp.

LETTER TO THE EDITORS.

The Pan-American Electrical Hazard.

To the Editors of Electrical World and Engineer:

Sirs.—In the ELECTRICAL WORLD AND ENGINEER, of Aug. 24, is an article (page 298) headed "The Electrical Hazard at the Pan-American." This article contains the substance of a report made by the National Board of Fire Underwriters' inspectors, G. D. Bruin, E. A. Fitzgerald and J. C. Forsythe.

The inference which the public in general would make from this report would naturally be that the installation had been poorly made

and that the Exposition would be wiped out by an electrical fire before the article could be printed. The entire impression produced by this report is manifestly unfair. The report makes five principal statements, none of which was true at the date of its writing; and apparently these statements were prompted by a desire to use them as a weapon of defence in a quarrel between the National Board and the Buffalo Board of Underwriters.

In an insurance inspector's line of work, the evident safe position to take, in passing his opinion, is to condemn, for in the event of loss by fire he can state "I told you so." In the event that no fire occurs he is permitted to state that the result was simply due to good fortune.

It would be useless to make an unsupported statement that the electric work at the Pan-American had been done carefully and thoroughly, and in accordance with the best practice, but fortunately, however, opinions can be readily had from the best engineers in the country as to the thoroughness of the work. It is a fact that during the above suggested controversy the work of nearly every electrical manufacturer in the country put in at the installation of their exhibits, was condemned by these same inspectors, as unworkmanlike and hazardous. I do not believe that any of the criticisms which Chairman Bruin sent out in regard to the Exposition's work were proper or even reasonable. Hence I desire to protest against the publication of their findings without the true facts of the case being brought out.

BUFFALO, N. Y. HENRY RUSTIN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Slotted Armatures.—E. DICK.—A theoretical article on the distribution of the lines of force is slotted armatures with highly saturated teeth. It has often been regarded as a rule that the maximum saturation of the teeth should not be over 18,000. He remarks that this rule is not justified, and that higher saturations have no disadvantages. He mentions a first-class machine, in which the saturation of the teeth is 24,000 lines (per square centimeter). High saturation of the losses enables one to reduce the copper losses on the armature. It also enables one to reduce the air-gap to a minimum. This is discussed analytically and illustrated by numerical examples. High saturation of the teeth also reduces the armature reaction. His final conclusions are, first, a dynamo is properly designed, when the air-gap is reduced as much as practical; second, the excitation, required for a larger air-gap, can suitably be used for overcoming the reluctance of the highly saturated teeth, so that more favorable dimensions of teeth and slots can be obtained.—*Elek. Zeit.*, July 25.

Maximum Efficiency of Direct-Current Machines.—FINZI.—A brief theoretical article. The losses in a direct-current machine, running at a given voltage, can be divided into two parts, one the "no-load loss," which is the sum of the losses due to friction of the bearing, air friction, and friction at the brushes, and the losses due to hysteresis and eddy currents at no load and to the Joulean heat in the coils of the magnet poles. The other "loss due to the load," this loss being proportional to the square of the armature current. He shows that the maximum efficiency corresponds to that load for which the "no-load loss" and the "loss due to the load" are equal.—*Elek. Zeit.*, Aug. 8.

Interpolar Induction and Distribution of Copper in the Armature of an Alternator.—WILSON and MARDEN.—The first part of a paper, illustrated by diagrams, in which they give the results of tests made with a Siemens & Halske 12-pole alternator, in order to investigate the following points: First, to find the distribution of induction between the two opposing pole-pieces in a given machine when the air space length is varied and the exciting current kept constant; second, to examine the effect of variations of air-space length upon leakage for a given exciting current, and, third, to find the most economical distribution of copper in an armature bobbin with the given air space and distribution of induction. They describe the method of their experiments and give some curves obtained, but no general conclusions are given in this part.—Lond. *Elec.*, Aug. 16.

New Insulating Material.—A note on a new insulating material which is brought out by a German firm and which is expected to supersede micanite to a large extent for insulating purposes, especially for the construction of commutators and the manufacture of field magnet spools. It is cheaper than micanite, and being made solely of mica and asbestos has the additional advantage that it can stand much higher temperatures without softening. The process of manufacture is briefly as follows: Moistened asbestos will adhere rigidly to mica so as to unite small pieces of the latter material, and the union thus produced remains even after the moisture has been removed. Small, thin plates of mica are, therefore, mixed with asbestos, or laid upon it, and the whole is moistened with water. The mass is then subjected to pressure by means of which the greater proportion of the water is removed and the mica and asbestos are said to be left as rigidly bound together as the individual laminæ is natural mica. Any moisture still remaining is removed by further pressure and simultaneous drying by the application of heat. The material can be made in the form of flat plates or sheets, or can be moulded into any shape required. The results of some tests, made by the German Reichsanstalt, with five samples of different thickness, are given. The plates were placed between two brass electrodes, each with a surface of 20 square cm., the upper electrode being weighted with 2 kilograms. For a plate of 1.3 mm. thickness, the insulation resistance was 27.3 megohms at 500 volts and 21.5 megohms at 1000 volts; the "sparking-through pressure" was 8000 volts with direct current and 7800 volts effective with alternating current. For another plate of 3.7 mm. thickness, the insulation resistance was 82 megohms at 500 volts and 72 megohms at 1000 volts; the "sparking-through pressure" with alternating current was about 16,000 volts effective, while it did not spark through with direct current up to 11,000 volts.—Lond. *Elec.*, Aug. 16.

REFERENCES.

Induction Motor with Power Factor Equal to Unity.—HEYLAND.—An English translation in full of his German article which was abstracted in the Digest last week.—Lond. *Elec.*, Aug. 16.

Construction of Alternators.—LASCHE.—A continuation of his very well illustrated serial on the construction and systematic manufacture of alternators. He deals with the size and arrangement of the centrifugal masses and gives formulas for the flying masses, which must be fulfilled to insure the desired degree of uniformity. He then describes in detail the mechanical construction of the inductor for very high speed.—Lond. *Eng'ing*, Aug. 16.

Traction Generator.—An illustrated description of a 500-kw, 550-volt traction generator of the Internat. Elec. Eng. Co., of Clun House, W. C., coupled direct to a Belliss high-speed engine.—Lond. *Elec. Rev.*, Aug. 16.

Self-Starting Single-Phase Motor Without Brushes.—An illustrated article on the motor of Fischer-Hinnen, described in the ELECTRICAL WORLD AND ENGINEER, June 22. It is said that a similar arrangement has previously been suggested by Sahulka, in 1891, for a two-phase motor.—*Zeit. f. Elek.*, July 28.

Manufacture of Alternators.—LASCHE.—The first part of a well illustrated serial in which he discusses the conditions underlying the construction and systematic manufacture of alternators of various types. In the first section he deals with the manifold conditions for standard types and the types hitherto produced.—Lond. *Eng'ing*, Aug. 9.

Rotary Field.—BERGMANN.—A mathematical article on the rotary field of a bipolar three-phase winding.—*Zeit. f. Elek.*, July 21.

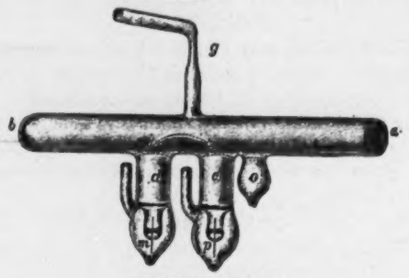
LIGHTS AND LIGHTING.

Mechanism of the Electric Arc.—HERTHA AYRTON.—A long abstract of an interesting (Brit.) Royal Soc'y paper in which she shows that the assumptions of a large back e. m. f. in the arc or of a "negative resistance" or of any other unusual attribute are entirely unnecessary, as all the principal phenomena of the arc may be accounted

for by applying the ordinary laws of resistance, of heating and cooling and of burning to the arc, considered as a gap in a circuit furnishing its own conductor by the votalization of its own material. When the carbons are once separated, all the material in the gap cannot retain its high temperature. The air must cool some of it into carbon mist or fog. The positive pole only volatilizes. She therefore considers that the arc consists of three essentially different parts: First, a thin layer of carbon vapor issuing from the end of the positive carbon; second, a bulb of carbon mist joining this to the negative carbon, and, third, a sheath of burning gases, formed by the burning of the mist and the hot ends of the carbons, and surrounding both. The vapor appears to be indicated in images of the arc by a sort of gap between the arc and the positive carbon, the mist by a purple bulb, and the gases by a green flame. The flame is found to be practically insulating, so that nearly the whole of the current flows through the vapor and mist alone. It is suggested that the vapor has a high specific resistance compared with that of the mist, and that it is to the great resistance of this vapor film that the high temperature of the crater is due, and not to any large back e. m. f. of which it is the seat. Volatilization can only take place at the surface of contact between the vapor film and the positive carbon. When that surface is smaller than the cross-section of the end of the carbon, it must dig down into the solid carbon and make a pit. The peculiar shaping of the negative carbon is due to its tip being protected from the air by the mist, and its sides being burned away under the double action of radiation from the vapor film and conduction from the mist. As nearly all the current flows through the vapor and mist, the surrounding flame being practically an insulator, the resistance of a solid carbon arc, apart from that of the vapor, must depend entirely upon the cross-section of the mist. To see how this varies with the current, images of an arc of 2 mm. were drawn, with the purple part—the mist—very carefully defined, for currents between 4 and 14 amperes. The mean cross-section of the mist was found to increase more rapidly than the current, consequently its resistance diminishes more rapidly than the current increases. As the resistance of the vapor film also diminishes faster than the current increases, it follows that the whole resistance of the arc does the same, and that therefore the p. d. must diminish as the current increases. The exact formulas are given. She then discusses under what conditions the partial differential quotient of the p. d. to the current measures the true resistance of the arc. Finally, she discusses in detail the changes introduced into the resistance of the arc by the use of cored carbons. The way in which the core acts in each case is traced, and the alterations in the specific resistance and cross-sections due to the core are shown to bring about changes in the p. d. exactly similar to those found by actual measurements.—Lond. *Elec., Elec. Rev.*, Aug. 16.

Bremer Arc Lamp.—LAPORTE.—A paper read before the Internat. Soc'y of Elec. in Paris, giving the results of tests of the Bremer arc lamp, made in the Central Laboratory of Electricity in Paris during the last Exposition. (The Bremer arc lamp has been described at some length in the Digest, July 28, and Sept. 8, 1900). As is known the characteristic features of the lamp are the arrangement of the carbons, which are nearly vertical, but form an acute angle; the regulation of the arc under the influence of a magnetic field, the regulation being made automatically by the intensity of the current, and the use of a special positive carbon, the composition of which is still kept secret. For a 43 to 45-volt and 9-ampere lamp the special positive carbon has a diameter of 7 mm., while for the negative carbon, a Siemens carbon of 6 mm. diameter is used. The special positive carbon has a considerably higher specific resistance, 12,300 microhms centimeter, that of the Siemens carbon being between 8300 and 9400. The positive carbon contains a certain number of metallic salts, and during combustion rather large quantities of deposits are formed, magnesia being the principal constituent. This magnesia is deposited on a screen above the arc which then acts as a reflector and produces a favorable distribution of the light. The color of the light is peculiar, it is between the color of the light of incandescent lamps and that of ordinary arc lamps without globe. The results of photometric tests and the comparison with an ordinary arc lamp are given in a table. The consumption of watts per candle for the ordinary arc lamp is about twice that for the Bremer arc lamp, the exact ratio, taken from the table, being $200 \div 117$. He says about the results of his tests: "It cannot be denied that these figures are favorable to the Bremer lamp. The only point which still needs to be cleared up is whether the price of the special carbon may not offset the advantage put in evidence by the photometric tests."—*L'Ind. Elec.*, July 25; *L'Eclairage Elec.*, July 20.

Mercury Lamp.—LUMMER.—The Arons mercury arc lamp (which is a forerunner of the Cooper-Hewitt lamp) is well adapted for polarimetric work, but has the disadvantage of being liable to burst, and its light is easily obscured by the condensation of mercury vapor. The present author obviates these defects by cooling the lamp in running water and giving it the shape shown in the adjoining diagram. Only the mercury bulbs *d*, *c* and *o* are submerged, the tube



MERCURY LAMP.

a b being free. The latter, therefore, remains at a higher temperature than the mercury and does not condense the vapor. The arc plays in the direction of the arrow, and is seen end-on. The tube is ground, except over a circular area at the end *a*, through which the light is viewed. He gives detailed instructions concerning the construction and mounting of the lamp. He made one pattern for magnetic work in which the tube is enclosed in a narrow box which can be introduced between the poles of a magnet.—*Zeit. f. Instrum.*, July; abstracted in Lond. *Elec.*, Aug. 16.

Incandescent Lamp Efficiencies and Lamp Renewals.—An editorial referring to Willcox's recent paper read before the Nat. Elec. Light Ass'n in which he recommended the general use of incandescent lamps having an efficiency of 3.1 watts per candle, and the adoption of free renewals for consumers by the central station authorities. In advocating the high-efficiency lamp Willcox is said to look at the question from the lamp manufacturer's point of view rather than from that of the central station engineer. A general increase in the efficiency of the lamps connected to the mains is simply a decrease in load, the revenue being diminished at the same time as the expenditure, and, of course, the reduction of standing charges would be in a smaller proportion than the reduction of load. The use of high efficiency lamps should be encouraged only as long as the net result is increased cheapness of light. Theoretically, it would be easy in every individual supply system to work out the best grade of lamp to use, but practically it is a very difficult problem. The custom of charging for current on the maximum demand system makes it still more complicated. Here it would theoretically appear to be better to install lower efficiency lamps for those burning long hours than for the others which are only alight for short periods, more especially if this is during the peak of the load. A system of free renewals of lamps in the form suggested by Willcox, "would be impossible in Great Britain, where every man's house is his castle. It is almost a grievance that the meter man should have entry, and the new-lamps-for-old man would hardly be more welcome." It is said that a free lamp system should either be based on the Bradford principle, where the lamps are delivered to the consumer at the works in number according to the amount of energy he has used, or on the still simpler system, suitable for smaller turns, of giving the consumer a new lamp if he brings a sufficiently old one in exchange for it.—Lond. *Elec.*, Aug. 16.

REFERENCE.

Bardon Arc Lamp.—MONTPELLIER.—An illustrated description of a new closed arc lamp made by Bardon.—*L'Elec.*, Aug. 10.

POWER.

Bulgarian Power Transmission.—PERKINS.—An illustrated description of the Isker-Sophia power transmission. The transmission line is 20 kilometers long. The capacity of the plant is 2000 horsepower. The voltage of the three-phase currents on the line is 7200. —*Jour. of Elec.*, July.

California Power Transmission Plant.—LOW.—The first of a series of articles on the transmission system of the Bay Counties Power Company. This article gives a nicely illustrated popular description of the transmission.—*Jour. of Elec.*, July.

Electric Power in Slate Quarries.—BRUNSWICK.—Continuations and conclusion of his well illustrated article (Digest, Aug. 3), on the electric power plant of a French company operating slate quarries. All the machines used are described in detail, among them Boucherot's compound alternator with its special exciter (see Digest, Oct. 27, 1900). The work in the quarries is also described.—*L'Elec.*, July 21, Aug. 3, 10.

Electric Elevators.—A long and well illustrated description of the new electric elevator of the Washington Monument.—*Eng. News*, Aug. 22.

TRACTION.

Automobile.—An illustrated article on an automobile which recently made a run of over 187 miles in Chicago on one charge. For this run it had two batteries of Porter cells of together 383 ampere-hours capacity and 600 lbs. weight. The carriage and motor weighed 600 lbs., so that the total weight of the rig was 1200 lbs. Some particulars are given on the construction of the automobile.—*West Elec.*, Aug. 17.

REFERENCE.

Baltimore.—A long illustrated article on the street railway system of Baltimore.—*St. R'y Rev.*, Aug.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

British Central Station.—An illustrated description of the Holyake and West Kirby electric generating station. There are three steam alternators, each giving 33 amperes at 2300 volts, the frequency being 50, and a motor-generator which is used either for charging the batteries or for converting the current supplied from the batteries into alternating current to supply the network. There are two batteries, each of 60 cells of a normal capacity of 500 ampere-hours.—Lond. *Elec. Eng.*, Aug. 16.

REFERENCES.

High-Tension Switches.—A full report on the discussion held at the recent meeting of the Pac. Coast Elec. Transm. Ass'n on high-tension switching and fusing practices. A number of papers on the same subject, presented at the same meeting, were recently noticed in the Digest.—*Jour. of Elec.*, July.

Communication in Generating Stations.—An article in which the methods of communication in electric generating stations, by signals or telephones, are discussed.—Lond. *Elec. Rev.*, Aug. 16.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Wooden Fittings.—JOHNSON.—An illustrated article on "Wooden fittings for electrical uses," dealing with the manufacture of poles, cross-arms, pins and brackets, etc.—*West. Elec.*, Aug. 24.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Effect of Electric Convection.—CREMIEU.—A reply to Wilson's criticism recently noticed in the Digest. He denies Wilson's objections to his experiments, because his apparatus was not of the construction supposed by Wilson. He remarks in general about his experiments: "In taking my experiments one by one, it is possible to point out in each some defect which might account for the negative result of that one experiment. But the general conclusions which I have stated are based on the ensemble of four widely different experiments, and are confirmed by a fifth, a very conclusive one, regarding the existence of open currents. Each of these experiments has, besides, been subjected to numerous criticisms. Up to the present, I have always met a criticism by an experiment, and this latter has always confirmed my conclusions." He therefore maintains that electric convection produces no magnetic effect, and that there is no electrostatic effect on a charged conductor due to a variable magnetic field.—*Phil. Mag.*, Aug. In a communication on another subject in the same number, Oliver Lodge congratulates Wilson "on his successfully destructive criticism of the over-emphasized experiments of Cremieu, and of the revolutionary deductions too readily promulgated on the strength of them."

Theorem in Rotary Fields.—CAMPBELL.—An illustrated "Note on a theorem in rotary fields." He has recently proven by analysis the following theorem: "If two alternating fields, A and B, of equal effective values and any wave forms be inclined to one another at an angle equal to the supplement of the 'power-lag' between A and B, then the resultant rotary field will have a constant effective value in all directions perpendicular to an axis of rotaion." (By "power-lag" he means the angle whose cosine is the power factor.) In this note he illustrates the theorem graphically.—Lond. *Elec. Rev.*, Aug. 16.

Dielectric Cohesion.—BOUTZ.—A gaseous mass placed in a uniform electric field allows the passage of an electric discharge as soon as the e. m. f. surpasses a critical value, below which the gas is a perfect insulator. He has tested whether the wall of the vessel in which the gas is contained has any effect upon the critical e. m. f. He found that no such effect exists.—*Comptes Rendus*, July 22; abstracted in Lond. *Elec.*, Aug. 16.

Current Through Conducting Cases.—RUTHERFORD.—An account of an experimental investigation. In the conduction of gases under the influence of Röntgen and Becquerel rays, it has generally been considered that the magnitude of the current between the electrodes is independent of the direction of the electric field, except in the case of potential differences of the order of one volt, when the contact differences of potential between the electrodes may cause inequalities in the currents. In the general case of gas conduction, however, the author has found that there is, in most cases, a difference between the values of the current with the reversal of the electric field. This difference is due to the inequality of the velocities of the positive and negative ions. It is only in certain special cases that the current is independent of the electric field.—*Phil. Mag.*, Aug.

Uranium Radiation at Very Low Temperatures.—BECQUEREL.—He has studied the radio-activity of uranium compounds at the temperature of liquid air. At that temperature the radiation is substantially the same as at ordinary temperatures. This supplements the fact that no variation is shown between the temperatures of —20 degs. and + 100 degs. Uranium nitrate, when plunged into liquid air, or liquid hydrogen, becomes luminous. This is an electric phenomenon due to molecular contraction. The luminosity only lasts while the crystal is cooling down, but it can be renewed by allowing it to regain the ordinary temperature, as the luminosity is seen both in heating and cooling. The phenomenon is intermittent.—*Comptes Rendus*, July 22; abstracted in Lond. *Elec.*, Aug 16.

Magnetization of Wires by Intermittent Current.—HONDA and SHIMIZU.—An illustrated account of an experimental investigation of the magnetization of iron, steel and nickel wires by intermittent current. For these wires, the magnetization in weak fields decreases as the frequency of the intermittent current is increased. On the contrary, the magnetization in stronger fields increases with the frequency. The diminution of magnetization by a definite frequency of the intermittent current becomes greater as the field is increased, till it reaches a maximum in a field near that of the maximum permeability. It then gradually goes on decreasing and continues in that state till there is increase in the stronger intermittent field. The field, in which the change of magnetization vanishes, increases with the frequency. The area of the hysteresis curve for the maximum field of 27.7 c. g. s. units increases with the frequency. It reaches a maximum and then gradually decreases. "As regards the explanation of these facts, it only suffices to assume with Wien that the magnetization has inertia."—*Phys. Rev.*, Aug.

REFERENCES.

Visible Radiation from Carbon.—E. L. NICHOLS.—The first part of a paper, read before the Am. Ass'n Adv. Sc., in which he gives an account of experiments in which he measured the temperature of carbon rods rendered incandescent by the passage of an electric current, and made spectrophotometric comparisons of the visible radiation from their surfaces with the corresponding wave length in the spectrum of an acetylene flame. In the present part his apparatus and method are described.—*Phys. Rev.*, Aug.

Electric Oscillations and Electric Waves.—J. A. FLEMING.—An illustrated reprint in full of his series of Cantor lectures, held at the end of last year. Abstracts of the same were mentioned before in the Digest. The first lecture on electric oscillations is in Lond. *Elec.*, Jan. 25, Feb. 1, 8; the second lecture, on electric resonance, in Lond. *Elec.*, Feb. 22, March 8; the third lecture, on the electromagnetic medium, in Lond. *Elec.*, May 3, 24, 31; the fourth lecture on electric waves, in Lond. *Elec.*, June 28, July 5, 12, 19, 26.

Dielectrics.—FLEMING and ASHTON.—Reprints in full of two British Phys. Soc'y papers, abstracts of which have been noticed before in the Digest. Fleming and Ashton, on a model which imitates the behavior of dielectrics, Ashton on the electrification of dielectrics by mechanical means.—*Phil. Mag.*, Aug.

Velocity of Becquerel Rays.—KAUFMANN.—A preliminary account of experiments in which he attempts to arrive at an accurate estimation of the ratio e/m for Becquerel rays. His results point to very

high velocities.—*Phys. Zeit.*, July 13; abstracted in Lond. *Elec.*, Aug. 16.

Ether.—LORD KELVIN.—A reprint, with additions and critical notes, of an old paper (1884) "On the possible density of the luminiferous medium, and on the mechanical value of a cubic mile of sunlight." The new title is "On ether and gravitational matter through infinite space."—*Phil. Mag.*, Aug.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Printing.—DARLING.—An abstract of an interesting lecture on the Friese-Greene process of electrolytic printing, the object of which is the supersession of printing ink with its accompanying complications. The same presses and type can be used as heretofore, but instead of inking the type, the latter is connected to the negative pole of some source of electricity. The paper used is impregnated with suitable chemicals, while the pressure rollers are connected to the positive pole. A current accordingly traverses the paper as it passes through the poles, and the chemicals being decomposed thereby, a sharp impression of the type appears on the surface of the paper. The amount of chemicals needed to give a good impression is small. Thus in one experiment with a silver nitrate paper the coulombs were measured and the amount of silver liberated was therefrom calculated. It was found that an eight-page newspaper can be printed with the liberation of 0.134 grains of silver. Silver nitrate is, however, only convenient for experimental work and unsuitable for practical use, as a paper impregnated with this salt turns black on exposure to light. The chemical originally suggested for the practice was a mixture of manganese sulphate and nitrate of soda, both of which are very cheap. By suitable chemicals prints of any color may be obtained. The rate of production is very great, and it is possible to print on both sides of the paper. It has further been suggested that the method might be applicable to the typewriter, the inking ribbon being done away with and the prepared paper used in conjunction with metallic type connected to the negative main of an electric lighting circuit.—*Eng'ing*, Aug. 16.

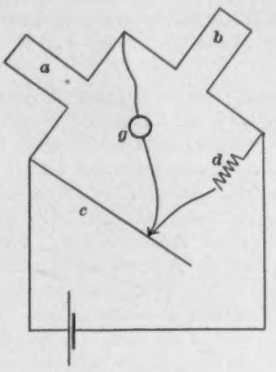
REFERENCES.

Polarization and Internal Resistance of Electrolytic Cells.—ATKINS.—The first part of a paper in which, after an introductory note, by Guthe, on the polarization capacity of electrolytic cells, and on a constant-current method for determining it, the author gives an account of an experimental investigation made to examine Wiedeburg's theory of electrolysis. A brief review of this theory is given and the apparatus and method used in the experiments are described. An account is given with tables and diagrams of the results obtained with copper sulphate between copper electrodes, silver nitrate between silver electrodes; platinum electrodes in sulphuric acid, zinc sulphate between amalgamated and algamated zinc electrodes. So far as there are no disturbing influences the results appear to be in agreement with the theory.—*Phys. Rev.*, Aug.

Handling Storage Batteries.—LEES.—An illustrated article, giving elementary rules how to treat a storage battery. The article is intended for attendants in small private installations.—Lond. *Elec. Eng.*, Aug. 16.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Direct Reading Conductivity Bridge.—APPLEYARD.—When it is required to check the conductivity of several tons of copper wire, of the same nominal diameter the method generally used resolves itself into making a careful test of the conductivity of the wire of a selected bank, and afterwards balancing a length of this on a slide-bridge against successive equal lengths of the remaining banks of wire of that diameter. If an ordinary slide-bridge is used, the scale readings corresponding to the balance position of the sliding contact are not directly proportional to the successive conductivities, but some calculation is required to find them. If, however, the slide bridge is arranged somewhat differently, the readings of the slider can be made to be directly proportional to conductivities. In the adjoining diagram *a* represents the resistance of the selected wire of known conductivity *A* and *b* the resistance of any of the remaining wire whose conductivity *B* is to be determined. The third arm of the bridge is a fixed resistance *d* and the fourth arm is the slide-wire *c*, the resistance of which can be adjusted to balance *d* by moving the slider. He shows that then the conductivity *B* to be determined, is equal to *c* multiplied with the constant ratio of *A* to *d*; the required conductivity *B* is therefore given in terms of the slide-wire reading. It is necessary that the contact between *c* and *d* should be invariable. He found that the best contact is obtained by a device resembling a drill-bow. The slider carries a small brass bow strung with one or more platinum wires, each of which passes once round the slide-wire. Vertical stops fixed to the slider prevent the platinum wires from lagging behind the bow as it is moved to right or left. Some remarks are added how to calibrate the instrument.—*Phil. Mag.*, Aug.



CONDUCTIVITY BRIDGE.

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Magnetic Measurements.—MONTPFLLIER and ALIAMET.—Continuations and conclusion of their illustrated serial on magnetic measurements with the ballistic method.—*L'Elec.*, July 20, 27.

Oscillographs.—BLONDEL.—The second part of his article on instruments for directly recording variable current waves. He deals with the applications of the oscillographs to the study of the electric arc.—*Rev. Gen. des Sc.*, July 30.

Volt and Ammeters.—An illustrated description of "column type indicating and recording meters." The principle on which the operation of this type of volt and ammeter is based "consists in causing the variations in the current to be measured to control the variation in pressure of a body of air in a closed vessel, this variation being in turn indicated or recorded by the rise and fall of a column of non-volatile liquid in a glass tube." The construction is described in detail.—Lond. *Elec. Rev.*, Aug. 16.

Meters for Variable Tariff.—GOISOT.—An article giving illustrated descriptions, mainly taken from patent specifications, of the following meters for variable tariff: Rasch, Aron, Union Elec. Co., Loubery, Francois, and Kunkelmann.—*L'Eclairage Elec.*, July 6.

Localizing Faults in Cables.—BETTS.—An article, illustrated by diagrams, in which he describes a new method of localizing a fault in a single cable. It is claimed to approach the loop test method in accuracy and simplicity. No second cable is required.—Lond. *Elec. Rev.*, Aug. 16.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Submarine Telephone Line.—An article on the steps that are being taken to establish telephonic communication between England and Belgium. Up to the present time there are only two submarine telephone connections of any appreciable length, viz., between Buenos Ayres and Monte Video, and London and Paris. The cables have a length of 45 km. and 40 km., respectively, while the total length of line is 302 km. and 515 km. Between London and Brussels the distance is 400 km., the submarine part between Dover and La Panne being 90 km. long. Arrangements are being made so that Birmingham, Manchester, Liverpool, Antwerp and Liege can make use of the line as well as the two capitals. Tests were originally made to see if it would be possible to establish communication between England and Belgium, via Lille and the Calais-Dover cable; but later further experiments were made on the three Anglo-French telephone cables in series, which showed that it was quite possible to talk through 120 km. of submarine cable. It was deemed advisable to make the overhead part of the line of copper weighing 800 lbs. per mile. (This corresponds to a diameter of about 5.7 mm.). The cable is a four-conductor one, i. e., with two telephone circuits, and each of the conductors is seven-strand, weighing 39.12 kg. per kilometer, and is covered with gutta-percha weighing 73.35 kg. per kilometer. It is expected that the maximum capacity of the core will not be greater than 0.1483 microfarads per kilometer. A brass tape is in-

terposed between the armoring and the core. The armoring consists of 16 galvanized iron wires. This is claimed to be not only the longest telephone cable which will have been laid, but the overhead parts will be the heaviest that have been used up to the present, for hitherto the maximum diameter of telephone conductors has been 5 mm. It is hoped that telephonic communication will be open before the end of the year.—*Trans. Soc. Belge d'Elec.;* abstracted in Lond. *Elec.*, Aug. 16.

Humming Telephone.—GILL.—A paper, illustrated by diagrams, in which he gives some notes on a humming telephone. Hibbard's experiment is referred to in which a telephone is held against or near to the diaphragm of the microphone and a hum or whistle is set up and continues. The microphone is in series with the battery, and with the primary of the induction coil. The telephone is in series with the secondary of the induction coil. The latter circuit also contains a reversing switch. A novel feature observed by him is that if the wires leading to the telephone are reversed by the latter switch while the instrument is humming, the note at once changes in a striking manner, and if the hum is stopped it will recommence again high or low, according to the side the switch is on. Several other observations are also noticed.—*Tel. Mag.*, Aug.

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Telephonic Newspaper.—An article on the telephonic newspaper of Budapest which transmits by telephone important news, reports from the Bourse, etc., and puts the subscriber into communication with the opera, concerts, etc. When the number of subscribers became 1200, difficulties were experienced in the operation which, however, have been surmounted so that it is claimed that 20,000 subscribers can now be connected to the paper. Some details of the installation are given and illustrated.—*La Nature*, July 20.

Telephony for Power Transmission Plants.—THEBERATH.—A paper read before the Pacific Coast Elec. Transm. Ass'n on "Telephone service in connection with long-distance power transmission."—*Jour. of Elec.*, July.

Multiple Telegraphy.—An illustrated article on the Mercadier multiple telegraph system.—*Sc. Am. Sup.*, Aug. 24.

New York.—An illustrated description of the Eighteenth Street central office of the New York Telephone Company, "a complete model installation on the common battery system."—*Elec. Rev.*, Aug. 24.

Poles for Line Construction.—An article giving practical formulas for calculating the sizes of poles for line wire construction.—*Tel. Mag.*, Aug.

MISCELLANEOUS.

REFERENCES.

Treatment of Lupus by Arc Light.—An illustrated article in the Lortet-Gounod method of treatment of lupus by arc light. The arc lamp used by them, is described in detail and illustrated.—Lond. *Elec. Rev.*, Aug. 16.

Glasgow Exhibition.—A continuation of the illustrated serial giving brief descriptions of several direct-current machines of British make.—Lond. *Elec. Rev.*, Aug. 16.

An illustrated article on electrical features of the Glasgow exhibition.—*West. Elec.*, Aug. 17.

A continuation of the illustrated serial giving brief descriptions of several three-phase machines of British make.—Lond. *Elec.*, Aug. 16.

New Books.

SHOP AND ROAD TESTING OF DYNAMOS AND MOTORS. A Practical Manual for the Testing Floor, the Car Barn and the Road. By Eugene C. Parham, M. E., and John C. Shedd, Ph.D. New York: Electrical World and Engineer. 627 pages, 211 illustrations. Price, $2.50.

The second edition of this excellent work contains 627 pages and 211 illustrations as compared with 538 pages and 163 illustrations of the edition which it supersedes. From the preface we learn that aside from corrections and minor changes, the new matter consists of two chapters on installation tests of car equipments. The first of these chapters takes up all of the various devices comprised in the equipment of a car in the order in which the current passes through them on the way from the trolley wire to the wheel, and a description in detail is given of the trolley, overhead switches, fuse box, lightning arrester, controller, starting coil and motor. The various forms in common use are in each case described, their practical points brought out and information given as to their application and use. As an example of the practical nature of the treatment, in the case of the controller the undesirability of running on resistance is dwelt upon, and other abuses referred to which may occur through careless manipulation. The second chapter gives instructions in full detail for testing a motor and equipment, the subject being treated under the heads of the testing circuit; testing the starting coil and the controller; motor tests; testing for motor polarity; setting the gear; mounting the motors; testing the gears; starting the car; grounds and short circuits.

To those who wish to obtain a thorough knowledge of the principles involved in the dynamo and motor, and in electrical measurement, this work should prove very useful in that respect alone, since the first seven chapters deal with the principles of the dynamo and motor, Ohm's law, the measurement of current, e. m. f., resistance and insulation; while to those desiring information on the practical testing of electrical machinery the work should prove invaluable—the second portion of the work treating of this subject under the heads of testing series, shunt and compound-wound machines; compounding tests; core-loss; testing for eddy current and saturation; brush and efficiency tests; tests for grounds on the line; motor testing. In addition, the new chapters, as above stated, cover street car equipment testing.

In reading the book one is impressed with its thoroughly practical character; indeed, the criticism may be offered that in endeavoring to cover every practical bearing of a subject, lucidity of development is at times sacrificed. This, however, will doubtless not be considered an objection by those who use the book in connection with practical work, and it merely involves a closer reading on the part of the beginner.

Directory of Electrical Societies, Etc.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Buffalo, N. Y., Sept. 10, 11 and 12, 1901.

ILLINOIS STATE ELECTRIC ASSOCIATION. Next meeting, Rock Island, Ill., Sept. 24 and 25, 1901.

RÖNTGEN SOCIETY OF THE UNITED STATES. Next meeting, Buffalo, N. Y., Sept. 10 and 11, 1901.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Owensboro, Ky., Oct. 8 and 9, 1901.

The Cable Works of the Allgemeine Electricitats Gesellschaft.

BY E. KILBURN SCOTT.

QUITE the finest factory which the members of the Institution of Electrical Engineers saw in Germany was the new cable works of the Allgemeine Electricitats Gesellschaft, situated at Oberspree, about 5 miles from Berlin. It was built so recently as 1897, and the area already covered by buildings is about 75,000 sq. ft. It is not quite correct to call them cable works, because the establishment includes a rolling mill for copper, brass, bronze and aluminum, and also for commutator and bus-bars; a factory for the manufacture of all kinds of insulation material, and rubber goods, such as india rubber hose, valves for pumps, washers for bottles, etc.; a department for the manufacture of mica insulators used for high-tension work, etc., and a factory where all kinds of Röntgen ray and wireless telegraphy apparatus are made. There are also machine and repairing shops for producing tools, molds, etc., and a joinery for making drums and packing cases.

The works are very favorably situated for the supply of raw materials, such as copper, lead, iron, coal, etc., either by water or rail, and for the delivery of finished products—cables, wire, etc.

Entering the works from the wharf we arrive first at the metal foundry. Here 15 furnaces are at work, 10 provided with a side blast of special construction and five furnished with a winding arrangement by which the furnace can be raised and the metal poured direct into a ladle for casting. In the machine shop are the ma-

chines for pressing commutator segments for dynamos, these being finished off with the greatest accuracy.

In the rolling mills raw copper, aluminum, bronze, etc., is rolled and drawn into wire. The heated copper bars pass successively through 21 different rolls from the bar to the finished wire, which is 6 mm. diameter (300 yards in length, weight 70 kg.), the whole operation taking 40 seconds. Both sets of rolls are electrically driven, the heavy rolls by means of a 200-hp, 500-volt, three-phase motor, and the finishing rolls by means of a 600-hp, three-phase motor at a tension of 1000 volts. There is also a smaller tin plate rolling press of 40 horse-power. The output of the rolling mills in 10 hours is 30 tons of 6 mm. wire and 10 tons of bars of various metal.

Next to the rolling mills is the cleaning room, where the wire is placed in baths containing diluted sulphuric acid in order to remove all oxide or other impurities. There are also five annealing furnaces for softening the copper wire after drawing, in order to render it soft enough to be drawn again.

The wire drawing mills have, besides the middle and fine wire drawing machines, 21 heavy machines and 10 multiple machines, These latter have each seven dies and represent the most advanced and improved construction which has been reached up to the present. The series of seven dies are arranged side by side, and after passing through the first die the wire is gripped by a power roller from which it passes again to the front of the machine and so through the next die. Again it is gripped by a power roller and so on through all the separate dies. The fine drawing machines are also multiple machines, the dies of which are fitted with diamonds in order to obtain the greatest accuracy in the finished wire. These machines draw wire down to .05 mm. or .002 inch diameter.

The main cable factory has six large lapping machines used for lapping either rubber or paper cables for high tension. There are also the usual wire winding machines, and the cable machines in which the wire is stranded and insulated with either jute, paper or a combination of jute and paper. After being coiled into baskets the insulated cables are put into large vacuum drying ovens heated by steam coils, the time being adjusted according to the quantity of material to be dried. The cable is next laid in a vacuum compound tank where it is impregnated and is then passed to the lead press. The lead presses are on the well-known Huber system, in which the lead is melted down from the pig as it is used. They work at a pressure of 200 to 350 atmospheres. The lead-covered cables are put under water for the usual 24 hours, and are then tested for insulation resistance and capacity. When for high-tension they are tested with double the working pressure, there being at disposal a pressure of 50,000 volts alternating from a transformer of 50 kilowatts. When a high-tension test is being taken that part of the laboratory that is dangerous is lighted automatically by red signal lamps.

In the armoring machines the test cables are passed from the drum at the back of the machine, first through compound and then successively served with paper, compound, jute, compound, two layers of steel tape, compound, jute, then two compounds and whitewash, and finally wound direct on to a drum for delivery.

The braiding room has no less than 350 small machines at work braiding flexible cords and insulated wires. The machine for insulating fine copper and resistance wires as small as 0.4 mm. with pure Milan silk were especially interesting. There are 88 such machines, each with from 20 to 40 heads running at a speed of 4000 r. p. m. In this same room there are also 200 braiding machines, which are exclusively used for braiding flexible cord with colored silk and cotton in various combinations of color.

The telephone machines, of which there are about 100, each with eight heads, are used for covering the telephone wire on the air-space system. The paper can be lapped spirally or longitudinally. In this latter case the telephone cables are paper-covered in rather a special way, the paper being folded lengthwise round the wire and kept in position by being bound round with two threads. When a number of wires are bundled up together these threads form the necessary air spaces. When covered the wires are laid up in the usual manner in twos and then stranded in layers in opposite directions in the large stranding machines up to 306 pairs.

In the rubber factory are to be seen the operations of masticating, cleaning and pressing gutta percha, and also the machinery for cleaning raw rubber. When mixed with the necessary pigments the rubber is kneaded in mixing rolls, and after being compounded are rolled into sheets by means of callenders. Part is used for moulded goods, and part for pure Para rubber tape 0.2 mm. thick. The pure rubber tape is vulcanized by means of chloride of sulphur.

In the micanite factory are produced sheets and moulded goods of various shapes, tubes, rings, disks, spools, etc. The mica plates are put together by means of shellac, and are afterwards pressed into moulds and dried.

The boiler house is equipped with six multitubular boilers by Babcock & Skinmüller, the steam generator being used for drying the cables, heating compound and for warming the buildings.

In the pumping station a Riedler express pump delivers 1.5 cubic millimeters of water per minute when running at 180 r. p. m., and driven by a 15-hp three-phase motor. In case of fire a pressure of 6 atmospheres can be obtained. Three other plunger pumps are in reserve.

The generating station, or transformer room, contains four revolving three-phase continuous-current transformers of a capacity of 110 kilowatts at 200 volts. These deliver current for the cranes, locomotives and the arc lamps. There is also an accumulator battery. Along the wall are 16 three-phase transformers, which transform down from 6000 to 1000, 500, 200 volts, as required for the various circuits. The total capacity is 2600 kilowatts, and current is obtained from the Oberspree station of the Berliner Elektricitats Werke.

All the running machinery is exclusively driven by three-phase motors, either singly or in groups, so that transmission by shafting is nowhere made use of. This enables the electric lighting to be carried out throughout by inverted arcs. There is no shadow, and so the workmen's eyes are not strained.

An electric locomotive is employed for shunting railway trucks, and there are also two electric locomotive cranes. These cranes have a jib of 5 metres and a lifting capacity of 4½ tons.

The dangerous nature of manufacture renders it necessary to have an extensive volunteer fire brigade, which consists of 40 workmen under the direction of an inspector of the Berlin Fire Brigade.

In front of the works there is the Casino, which has four halls with sufficient space for accommodating 1600 persons. In the principal hall weekly lectures of a scientific and instructive character are given. The ground floor contains bathrooms, also a surgeon's room in order to have speedy help at disposal in case of accident.

Everything possible is done as regards care for the workmen's welfare. A special invalid fund has been provided and provision is also made for material assistance in cases of protracted illness. There is also a convalescent home favorably situated, which will accommodate 200 inmates.

By wireless telegraphy on the Slaby-Arco system messages can be sent to the Central Depot in Berlin, over a distance of 10 miles. The wires hanging from the main shafts serve for sending and receiving the electric waves. It may be mentioned that the firm has supplied a large number of instruments to the warships of the German Navy, and they have also recently installed instruments on the imperial yacht "Hohenzollern."

Electric Automobile Tests in Cleveland and Chicago.

By FREDERICK CARRINGTON PHILLIPS.

THE readers of the ELECTRICAL WORLD AND ENGINEER will doubtless be interested to learn of two record tests made recently on an electric automobile in Cleveland and in Chicago, as already noted briefly in these pages. The tests were made to demonstrate the possibilities of long distance travel with an electric automobile on one charge of its battery, and at the ordinary speed such as is now, or will be, the general practice in cities, namely, about 10 to 11½ miles per hour. The common objection that is raised to an electric motor vehicle is that it will not cover enough miles in town service. I think that we have completely demonstrated that there can be constructed a perfectly practical electric vehicle that will run long distances in city use and also comparatively long distances over fairly good country roads, and yet such vehicle will not be of special weight or be otherwise other than perfectly practical. The two tests that I describe below amply demonstrate this proposition.

Test 1 was made from the late evening of July 12 to midday of July 13 in Cleveland, on clean, first-class streets and boulevards that are paved with stone, brick and asphalt, and that are more or less up and down grade, but not very much so.

The second test was made in Chicago on the south side avenues and boulevards, for the most part excellent macadam pavements, from the evening of Aug. 5 to about midnight of Aug. 6.

In the first test we covered on a practically continuous run with

one charge of the battery, a distance of 151 miles at an average speed of 10.91 miles per hour, with a consumption of 4275 watt-hours. The weight of the vehicle with its passenger was just under 1100 lbs. (1090 lbs., to be exact). This works out, as will be seen, at practically 52 watts per ton mile.

In test 2, made in Chicago, as described above, we covered 187½ miles on one charge, and at a speed that was a trifle over 9 miles per hour. In this case, however, we had on board a larger battery that weighed 600 lbs., and the total weight of the vehicle with passenger was 1400 lbs. The consumption of power in this case was substantially 55 watts per ton mile. The weight of the battery in test No. 1 was 350 lbs.

The vehicle itself is a Baker-Stanhope, the body being of our own design. The motor is of special Elwell-Parker design and manufacture, such as we are regularly furnishing to the Baker Motor Vehicle Company, of Cleveland. The battery in both cases was that furnished to us by the Porter Battery Company, of Chicago.

The vehicle with its electric equipment and battery are of the regular type that are on the market, and are in no way specially designed for the particular tests that we made, since we were desirous of demonstrating, not what could be done with a specially constructed rig, but what could be done in regular practice by a commercial electric vehicle. I think that the above results, especially in the direction of the efficiency, as indicated by the watts per ton mile, are quite unequaled, by a large margin, by any results that have been obtained heretofore in an electric motor vehicle.

ELECTRIC AUTOMOBILE.

These efficiency results are due primarily to the high efficiency of the motor and running gear of this vehicle, a large part of the good results being due to the fine design and construction of the latter part, although, of course, the high efficiency of the motor on the various currents that are required in driving at the various speeds in a practical run, cuts a large figure in obtaining these satisfactory results. In addition, of course, due credit should be given to the battery for its comparatively large storage capacity with the minimum of weight.

I may remark, in passing, that these runs were practically continuous, excepting for intervals necessary for the chauffeur's rest and refreshments, and once in the case of the Cleveland test, and again in the case of the Chicago test, for replacing tires that were punctured or that otherwise came to grief.

The above tests have demonstrated the electrical and mechanical efficiency that are attainable in electric automobiles, and show that whereas the speeds obtained in these trials were not very high, it is quite feasible to secure as high if not higher efficiencies on higher speeds, as, for instance, at 15 miles an hour or more. This presumption is justified, as it is well known that moderately increased speeds are obtainable with a well-made vehicle with far less additional power consumption than is the case with a very rapidly moving object through the air, or, in the case of a vessel moving through the water.

New Equipment for Ottawa, Canada.

The Ottawa Electric Company, whose plant was destroyed in the great fire in that city some time ago, has recently contracted with the Westinghouse Electric & Manufacturing Company for a new equipment, of which we illustrate herewith one of the three 700-kw generators, to be equipped for waterwheel connection, one of two 700-kw belted generators, and one of three 250-hp induction motors. In addition there will be supplied one 300-kw rotary, with two 165-kw transformers, one motor-generator outfit of 22½ kilowatts capacity, one 37½-kw slow-speed multipolar generator and a special 56½-kw multipolar type generator.

Each of the 700-kw turbine-driven generators is a two-phase machine, and is to be of the two-bearing type, with a coupling on the shaft for direct connection to the end of a waterwheel shaft, revolving at a speed of 180 r. p. m. At 60 cycles each machine will have an output of 159 amperes per terminal at 2200 volts under a non-inductive load. The external frame will be divided in a vertical plane and movable from the shaft to permit easy access to windings. In all, there will be 40 poles upon this frame. The winding of the field coils is to be of strap on edge. The armature of the slotted drum type, will be built up of laminated steel of the highest magnetic quality. Its wire-wound coils will be continuous and retained in position by fiber wedges. The two-phase current will be collected by special brass rings of the open ventilated type employed by the Westinghouse Company. The temperature conditions and regulation will be excellent.

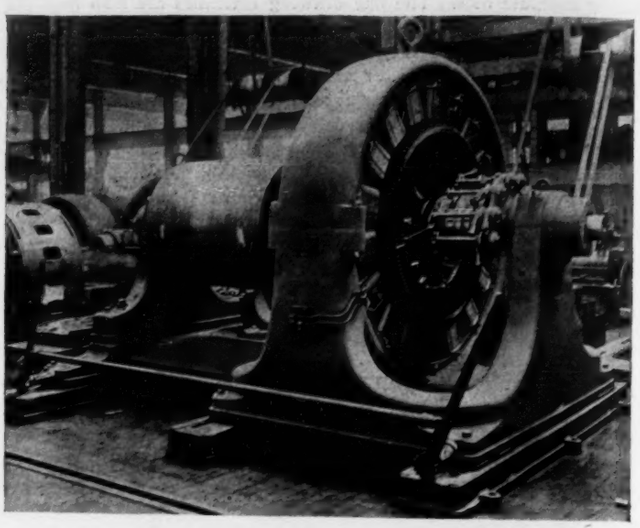


FIG. 1.—700-KW, TWO-PHASE, BELT-DRIVEN GENERATOR.

The requirements of the Ottawa Electric Company were that the generator should under a non-inductive load have an efficiency of not less than 83 per cent at one-quarter load; 90.5 per cent at one-half load; 93 per cent at three-quarters load, and 94½ per cent at full load.

The machine will operate for 24 hours at 2200 volts, and at 159 amperes per terminal, at from 90 per cent to 100 per cent power factor with a rise in temperature not to exceed 40 degs. C.; at 25 per cent greater current with the same power factor for 24 hours the rise in temperature will not exceed 50 degs. C.; at 50 per cent greater current the rise in temperature will not exceed 60 dgs. C.

The 700-kw belted generators are of the three-bearing type with rotating armature. Each will generate two-phase currents at 2200 volts, 159 amperes per terminal under a non-inductive load. The journals will be self-oiling and self-aligning, while the shaft will carry a pulley 58 inches in diameter and 72 inches in face. The frame of the horizontally divided type will contain 22 poles, and at a speed of 327 r. p. m. the frequency of the machine will be 60 cycles. The regulation will be very close. In the case of this machine the Ottawa Electric Company requires that, on a non-inductive load, the efficiency should be less than 84 per cent at one-quarter load; 90½ per cent at half load; 93 per cent at three-quarters load, and at full load 94 per cent.

The field coils will be wound with strap on edge and are to be placed on pole pieces so designed as to reduce the armature reaction and the self-induction to a minimum. The armatue coils are to be

continuous, wound from strap copper and retained in place by wedges of hard fiber.

The 250-hp induction motors are to be two-phase, Type "C," Westinghouse constant-speed C motors, with self-oiling and self-aligning bearings. They are intended to operate directly on the 2200-volt circuit at a speed of 580 r. p. m. under full load. Each is a 12-pole motor weighing approximately 11,000 lbs. The parts are a cylindrical yoke carrying the primary windings, and to which will be bolted circular end brackets to carry the bearings, and a rotating squirrel-cage secondary. The motor will have an efficiency of not less than 90 per cent under its full load of 250 horse-power, and a power factor of not less than 91.5 per cent. The temperature conditions are a normal load for 24 hours, with a rise not to exceed 40 degs. C.; a 25 per cent overload for 24 hours with a rise not to exceed 50 degs. C., and a 50 per cent overload for one hour with a temperature rise not to exceed 60 degs. C. It is intended to place a 125-light Brush arc machine on each end of each motor and to make direct connections by suitably flanged couplings.

FIG. 2.—700-KW, TWO-PHASE REVOLVING ARMATURE GENERATOR.

The 56½-kw generator is of the special multipolar type, compound wound for 125 volts, and is intended to operate at 475 r. p. m.

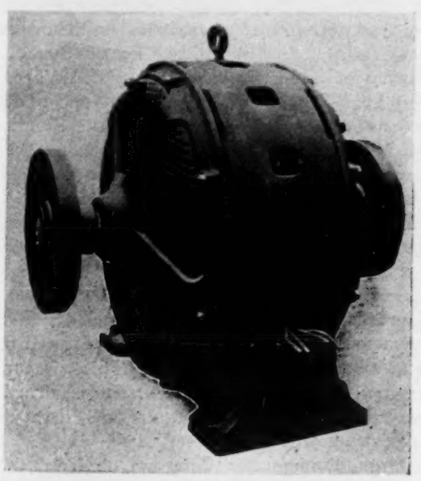


FIG. 3.—250-HP INDUCTION MOTOR.

Its shaft is to be extended that the coupling may be placed outside of its pulley, and each machine is to be equipped with belt-tightener, base plate, flange coupling and pulley. Each of the 37½-kw direct-current generators is to be of the slow-speed multipolar type, compound-wound at 125 volts. The motor-generator outfit is to consist of one 22½-kw direct-current generator compound-wound for 250 volts, and one 30-hp, slow-speed direct-current motor shunt-wound for 500 volts.

A Southern Power Plant.

The Fries Manufacturing & Power Company's power house is located on the Yadkin River, about 14.5 miles from Winston-Salem, N. C. The enterprise was undertaken by the Fries Manufacturing & Power Company in 1898, and has been in successful operation ever since. The dam is 10 ft. high and 500 ft. wide, and will furnish from 2500 to 3000 horse-power. All the buildings at the river are of rubble masonry, and go to bedrock for their foundation. The power house is built into and constitutes one end of the dam, and is divided into eight compartments, each containing two 54-inch McCormick turbines. The wheels are in vertical position, and eight of them are connected to a horizontal shaft which is connected direct to the generator shaft by means of flexible coupling driving a 750-kw, three-phase S. K. C. generator wound for 12,000 volts, 66 cycles at a speed of 166 r. p. m. The other eight turbine wheels are connected in the same way to a second generator of the same size and make, the two generators running in parallel.

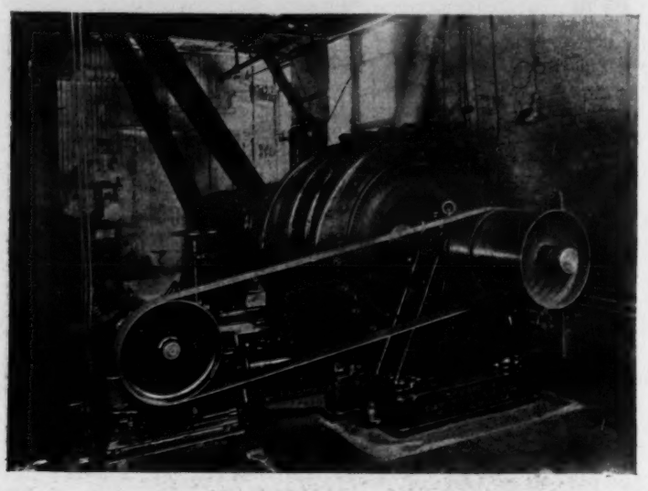


FIG. 1.—COTTON MILL GENERATOR PLANT.

The current is carried from the power house to the sub-station at Salem, N. C., on three No. 1 bare copper wires, where, by using step-down transformers, a portion of the current is reduced to 1200 and 2300 volts. One high-tension circuit is run to South Side Cotton Mills, 11,500 volts, where it is transformed to 600 volts, operating two 300-hp S. K. C. synchronous motors, also driving a large motor for the Salem water works. One circuit runs to the Southern Chem-

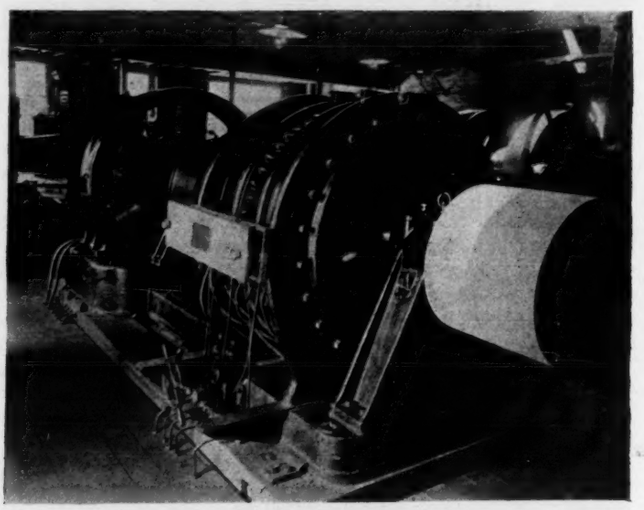


FIG. 2.—RAILWAY POWER HOUSE.

ical Company, driving a large number of motors of various sizes, from 20 to 80 horse-power.

The remaining high-tension circuits enter the railway and electric light power house at Winston, N. C. Current is reduced to 1200 and 2400 volts by step-down transformers, which are furnishing power to two 300-hp S. K. C. synchronous motors driving two 200-kw, direct-connected dynamos, furnishing power for street cars; also current for 200 arc lights and about 4000 incandescent lights. Power is also supplied to Fries woolen mill, 80-hp S. K. C. motor, and Fries cotton mill, 300-hp S. K. C. motor. Many other enterprises, furniture fac-

FIG. 3.—THE RIVER PLANT.

tories, knitting mills, tobacco factories, etc., are furnished exclusively with power.

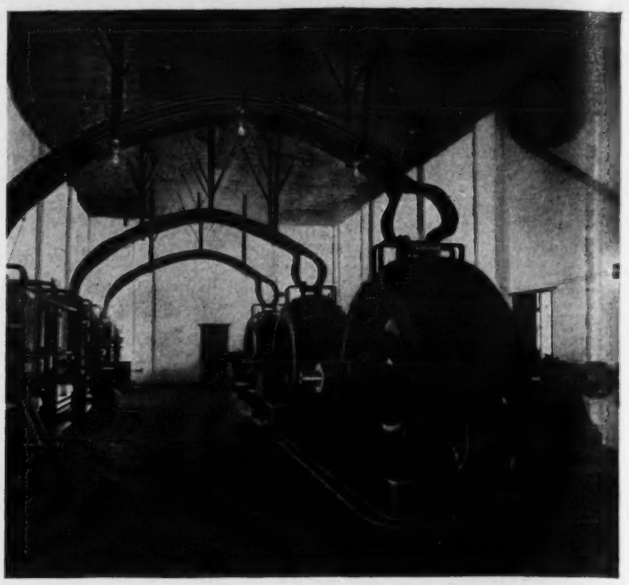
The railway power house also has a steam plant as reserve, consisting of four boilers and three engines of the Armington-Sims and Ball types in case of dry season. The generators, motors and transformers are all of the well-known S. K. C. system, and the lines are protected by S. K. C. lightning arresters, manufactured by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

Electric Reduction Plant in West Virginia.

At the falls of the Great Kanawha, some 36 miles above Charleston, W. Va., is a great industrial enterprise that has in it far more of interest than attaches to the manufacturing of ordinary articles of commerce. It is the Willson Aluminum Works, which are employed in the reduction of chrome ore and the manufacture of ferro-chromium, which is utilized in the hardening of the steel of which armor plates for war vessels are made. When the Willson Company entered the ferro-chromium business they had to deal with ore so refractory that only electric heat was practicable for its reduction. It became necessary, therefore, to obtain a site for their plant where current could be generated at a minimum of cost. For this reason Kanawha Falls was chosen. Here New River, which is joined by the Gauley about two miles above, rushes over a precipice some 26 ft. high, and is thereafter known as the Great Kanawha. The fall makes one of the finest water powers in that region, careful estimates showing that at the lowest stage 8000 ehp can be developed. Across the river, on the top of the solid rock forming the falls, the Willson Company has built a dam, and on the north side an electric plant of 3000-hp Bullock alternating-current generators of the revolving field type has been installed, and is now at work. The remainder of the power will be developed by machinery soon to be put in on the south side of the river.

In the heat kindled by this 3000 horse-power current the chrome ore is reduced to ferro-chromium, or as it is usually called, ferro-chrome. The ore reduced to pure metal is not picked up on the wooded mountain within easy reach of the company's works. Chrome ore is found in a number of places on the globe, but there are many qualities of it, and this company requires what is best suited to the special purpose for which it is intended—that is, which contains the highest ratio of chrome and the smallest proportion of iron. The ore used is from Australia and Asia Minor, most of it being from the latter country. It is taken from the mines and carried many miles on the backs of camels to a port on the Black Sea, where it is put on shipboard and sent to this country, coming from the seaside to Kanawha Falls by rail. The metal produced from this ore is 70 per cent chromium.

The entire output of the plant is contracted to the Carnegie Steel Company and the Bethlehem Steel Company to be used as alloy in



THREE 600-KW, THREE-PHASE GENERATORS.

hardening the steel for the armor plates which those companies are making for the United States Navy. To supply this demand the Willson Works will be run to their full capacity during the life of the Carnegie and Bethlehem contracts with the Government. Ferro-chrome is also used in making the projectiles used in modern warfare, thus appearing on both the offensive and defensive sides of the conflict.

A Feature of Three Wire Secondary Distribution.

The past two or three years have witnessed the very general introduction of the 110-220-volt alternating-current, three-wire system. The advantages of this method of secondary distribution, using large transformers situated at suitable points, are so well known as to require no further explanation. Attention has been called, however, to the disturbing effect such a method of distribution exerts upon the core-type transformer when wound in the ordinary manner; with a primary and a secondary on each leg of the core, there being thus two primary coils and two secondary coils. When connected to a three-wire system it will be observed that one of the secondary coils is thus connected across each branch of the circuit. If one side of the system is loaded and the other side unloaded, the transformer therefore is supplying current from one of its secondary coils, and no current from the other secondary coil.

The effect which this has upon the regulation of the transformer has been stated to be so pronounced as to prohibit practically the use of such a transformer for this service. Taking the extreme case where the one side is fully loaded and the other side unloaded, it has been observed that the voltage on the loaded side dropped from 100 volts down to 80 or 85 volts, while the potential on the loaded side rose from 100 up to 115 or 120 volts. This, of course, is the extreme effect, and as the regulation becomes normal when both branches carry the same loads, the regulation will vary from normal to the prohibitive condition mentioned.

The Pittsburgh Transformer Company observed this peculiarity of the usual core type transformer, and at once sought a remedy for the trouble. It was recognized that the effect was caused by the excess of current in the one coil over the other, this apparently causing a leakage of the magnetic lines of force. The lines of force being forced out of the heavily loaded coil, caused an excessive drop in voltage in that coil and, to make matters worse, the lines thus forced out of one coil appear to have been crowded into the other coil, thus raising its voltage as far above the normal as the first coil

is below normal. The solution evidently was to wind the several coils of the transformer in such a manner that the disturbing effect of the excess current in one side should have absolutely no effect upon the distribution of the magnetic lines which thread the assembled coils.

In experiments attacking this problem, some curious effects were brought out, one of which may be of general interest. It was observed with a 1-kw transformer, which was wound for 100-200 volts with the common style of winding mentioned, that no unbalancing effect was to be detected. This transformer was not mounted in the cast iron case. Another transformer wound in precisely the same manner, but which was mounted in the case, showed the effect most markedly. This second transformer was then removed from the casting and again tested. It was observed that this also failed to show the unbalanced effect looked for. It was then evident that the casting surrounding the transformer was responsible for at least a portion of the magnetic leakage which produces the above described distortion upon the voltage.

The winding which was adopted by the Pittsburgh Transformer Company was carefully tested under various conditions, and it was demonstrated that normal regulation, that is, the regulation which is obtained upon the common two-wire system, was exhibited under all variations in the load. With one side of the system fully loaded, and the other side entirely unloaded, the difference in voltage between the two sides was that due simply to the ohmic drop, and was equal in amount to the normal regulation. This method of winding the core type transformer is said to be broadly covered by U. S. patent No. 680,421, issued to Frederick C. Sutter and Robert V. Bingay, and controlled by the Pittsburgh Transformer Company, which in its Bulletin No. 7 discusses the three-wire system of distribution using large transformers with 110-220-volt secondaries. The advantages of this system are pointed out and the methods of construction used in a type of transformer adapting it to this peculiar service are also shown and illustrated.

A New Lumen Meter.

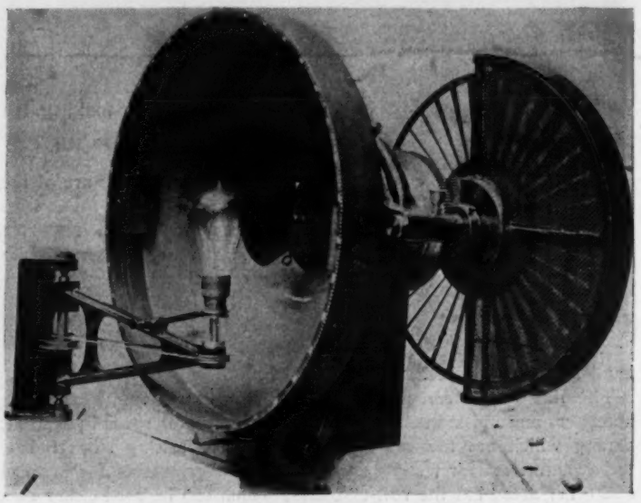
Messrs. Queen & Co., of Philadelphia, have just completed and put on the market a new form of lumen-meter, designed for the rapid measurement of the mean spherical candle-power of incandescent lamps. This instrument is manufactured under the patents of Messrs. Houston & Kennelly, and is a modified design of the arc light lumen-meter described in an article by Professor R. A. Fessenden in the pages of this journal some time ago.

Employing this instrument it is possible to measure accurately with one setting of the sight box, the mean spherical candle-power of any incandescent lamp, regardless of the shape of the bulb or filament. Persons accustomed to taking the large number of settings heretofore necessary in obtaining the mean spherical candle-power, and even then only arriving at an approximate result, will greatly appreciate this instrument as it is now possible to make measurements in as many minutes as heretofore required hours to complete.

As will be seen from the illustration the instrument consists of a funnel-shaped hood carrying a small mirror in the rim. This hood is mounted in ball bearings on a substantial iron base and arranged so that it can be rotated at any desired speed by means of a belt and suitable power. At the bottom of this funnel and rotating with it, is mounted another mirror, the mechanical construction being such that the beam of light from the incandescent lamps falls on the mirror in the rim of the hood and is reflected to the center mirror, whence it passes through an opening in the axis of the apparatus and down the photometer track to the screen. At the far end of the axial opening is arranged a circular metallic disk which revolves at twice the speed of the mirrors. This disk is perforated with different size slots which consecutively pass through and intersect the beam of light and at regular intervals cut off more or less of it. For example, when the mirror has the position shown in the illustration, the slot in the disk is a maximum and allows all the light given by the lamp to pass through. When the mirror is rotated 90 degs. from this position, consequently directly over the top or under the base of the lamp, the disk has revolved to a point where there is no opening so that no light falls on the photometer screen. The various intermediate openings are cut accurately so that at various intermediate positions of the mirrors a correct proportion of light is intercepted.

It will be noted that it is also possible to measure the candle-power of the lamp at any inclination to its axis by merely removing the disk and not rotating the lamp, making the setting at which it is desired to measure the candle-power by means of the scale on the edge of the hood and pointer beneath the lamp.

To make a measurement for mean spherical candle-power the lamp to be tested is placed on the adjustable bracket and rotated about its vertical axis at its usual speed for mean horizontal measurements.



LUMEN METER.

The hood is set so that the mirrors occupy the same position as in the illustration, and the potential at the lamp terminals so adjusted that the rated candle-power is produced. The hood is then rotated at a suitable speed, between 200 and 300 r. p. m., and another measurement made. This reading will indicate the mean spherical intensity at the same voltage at which the lamp gave the mean horizontal candle-power of 16. The apparatus shown is built for testing incandescent lamps in large numbers for their mean spherical intensity.

Hand Microphone.

The accompanying illustration shows a hand-microphone put on the market by the Couch & Seeley Company, Boston, Mass. The specially distinctive feature in this article is that it is adjustable as regards the distance between the receiver and the mouthpiece of the microphone. This is accomplished by loosening a screw in the handle and drawing out or closing up the appliance as one does with a telescope. There is no change in the outward appearance or finish. The microphone is their standard long-distance coal grain type, with

HAND MICROPHONE.

gold electrode and bipolar receiver. The mouthpiece is aluminum, highly finished, and the handle is of polished hard rubber. The switch lever in the handle is fitted with double contacts (unless specially ordered with single), thus requiring no automatic hook when used with either a magneto bell, push button or common battery system.

This type of instrument is used in all of the Couch & Seeley portable sets and iron box telephones for the talking circuit, and is claimed to possess many advantages. It is also convenient for desk use, as it can be placed in a drawer, hung up on a dummy hook or laid down in any position, and the instant the lever in the handle is released, the talking circuit is broken and the ringing circuit completed.

Pocket Measuring Instruments.

The accompanying cut represents a combination volt-ammeter, one of a line of small measuring instruments made by Louis M. Pignolet, of 78 Cortlandt Street, New York City, of sufficient size to secure accuracy and a fair range, but at the same time small enough to fit in the pocket or tool bag, the size being twice that of the illustration.

These instruments are of the permanent magnet type, with magnets of special imported steel, and carefully treated to insure permanency. The construction is thorough; the pivots of the moving parts are hard and sharp, and rest in jewels. The scale divisions are made by hand and are of practically equal width.

The line of instruments comprises voltmeters, ammeters, volt-ammeters and mil-ammeters in various readings for special purposes, among which are low-reading voltmeters for testing storage batteries, ammeters for testing dry batteries, mil-ammeters for medical and other uses; but the volt-ammeters which can be used either as a voltmeter or as an ammeter are particularly useful to those having the care of batteries and telephone, annunciator, fire alarm or other battery circuits.

The condition of the battery can be ascertained as well as that of the circuit. The current flowing through the circuit can be measured to ascertain if it is normal. Grounds, short circuits, etc., can be detected by the drop in voltage on the line and located by testing the line from place to place.

American Electrical Apparatus for Japan.

Takata & Co., of Tokio, Japan, and of New York City, have recently placed contracts for a large plant to go in the Shiramine Dockyard, Japan, where the apparatus therefor will be largely, if not wholly, of American make. The orders include two 150-kw Westinghouse 250-volt direct-current engine type generators, which are to be direct connected to Westinghouse engines, to operate in multiple and to over-compound from 220-volt, no-load, to 250-volt, full load. There will also be a Westinghouse switchboard and one Westinghouse 50-hp slow-speed multiploar shunt-wound motor, 220 volts, running at a speed of 550 r. p. m., together with the usual accessories, such as field rheostat, single-pole starting rheostat, switches, etc. The concern have also ordered one Westinghouse 76-hp, 220-volt, direct-current shunt-wound motor, which operates at a speed of about 300 r. p. m., to be direct connected to two centrifugal pumps manufactured by Gwynne & Co., of London; and a 9-hp, 220-volt, shunt-wound, direct-current motor, operating at about 715 r. p. m., to be direct connected to a centrifugal pump of the same make and mounted on a common base with this pump.

The steam plant furnished by Westinghouse, Church, Kerr & Co. comprises two Westinghouse vertical cross compound automatic condensing engines, size 16 by 27 by 16, running at a speed of 225 r. p. m. These engines will develop 275 ihp, running at the above speed with 125 lbs. pressure at the throttle and 26-inch vacuum, and will be furnished with the necessary extended bed plate, crank shaft and outboard bearing, said shaft arranged to receive the armature of the generator. For furnishing steam the Heine Safety Boiler Company will supply two water tube boilers, each rated at 176 horse-power. These boilers are designed to carry a safe working pressure of 160 lbs., but it is the intention to operate them at 125 lbs. pressure at the throttle.

The steam plant will also include a Knowles patent horizontal air pump and jet condenser, size 12 by 18 by 18, with a capacity of about 10,800 lbs. steam per hour to be used in the main engines, and two Knowles special duplex feed pumps, pressure pattern, size 4½ by 2¾ by 4. The capaciy of both cylinders of each pump in gallons per minute is from 20 to 40.

The Taunton Locomotive Works will furnish for use in connection with this plant two Wainwright even-flow water tube heaters, 250 horse-power capacity each.

Takata & Co. have also placed with the Westinghouse Electric & Manufacturing Company another order for a 125-volt standard speed compound-wound generator, together with switchboard, etc., this outfit being intended to be used to furnish power to operate ventilating apparatus in the House of Commons. The concern is also about to ship a complete hoisting outfit, which consists of a Lidgerwood hoist having a friction drum of 30-inch diameter and 24-inch face. This drum is geared to give a rope speed of about 100 ft. per minute, and to be connected to a Westinghouse direct-current 15-hp, 500-volt motor. There is mounted on the hoist a Westinghouse controller, the necessary resistance being placed under the frame in a convenient place. This hoist is intended for the Ashio Mine, one of the largest copper mines in Japan.

FLEXIBLE PENDANT.

Flexible Steel Armored Conductors.

In the accompaning illustration is shown a section of flexible cord with rosette and terminal bushings, which constitute part of the interior wiring system of the Sprague Electric Company, New York. This cord is particularly useful for lamp pendants and portables under conditions requiring extraordinary service, such as in machine shops, theaters, mills, show windows, factories, engine and boiler rooms, etc.

The success of these products is largely due to the high grade of insulation surrounding the conductors, the perfect mechanical protection afforded by the steel armor, and the lower first cost when compared with metal conduits, plus conductors.

The Coal Handling Installation of the Boston Elevated.

The Lincoln's wharf power station of the Boston Elevated Railway, as already noted in these pages, is an excellent example of the most modern engineering practice. The building is 155 by 145 ft. in area. The pumps, condensers and all piping are placed below the level of the engine-room floor. The boiler room is at a slight elevation above the ground, and the coal is carried above this in steel pockets. The capacity of these pockets is 3500 tons of coal and room for 6500 tons more is reserved on the company's wharf adjacent to the building.

The total nominal horse-power of the boilers is 6000, there being six batteries, each consisting of two 500-hp water tube Babcock & Wilcox boilers. The 12 boilers are equipped with mechanical stokers and fuel economizers. The continuous operation of the generating machinery depends upon the continuous supply of coal to the boilers. The authorities of the Boston Elevated Railway made a thorough investigation, and decided to install an equipment of coal conveying apparatus manufactured by the C. W. Hunt Company, of West New Brighton, Staten Island, N. Y.

The power house equipment of coal-handling machinery consists of two complete systems of Hunt standard noiseless gravity bucket conveyors, each about 500 ft. long, and with a maximum lift of about 100 ft. This conveyor differs from the ordinary chain conveyors in many particulars. While it is usually called a conveyor and classed with this machinery, it is, in fact, a series of cars linked together, each having a body hung on pivots, gravity keeping them in an upright position, no matter whether the track is horizontal,

vertical or inclined. It is carried on wheels fitted with self-closing oil cups and oil reservoir, is electrically driven and is noiseless in operation. All shafting is ground on dead centers, and runs in removable bronze bushings. All gears are machine cut and pressed on taper shafts. Careful provision is made for thorough oiling, and all parts are made to gigs, tools and templets on the interchangeable system.

The motion of the conveyor is obtained by pawls pushing the chain along. The pawls give a steadier motion and permit the power to be applied at any point in the conveyor chain. The wear on the pawls is an insignificant amount, as all the working bearings are of ample area and can be thoroughly oiled.

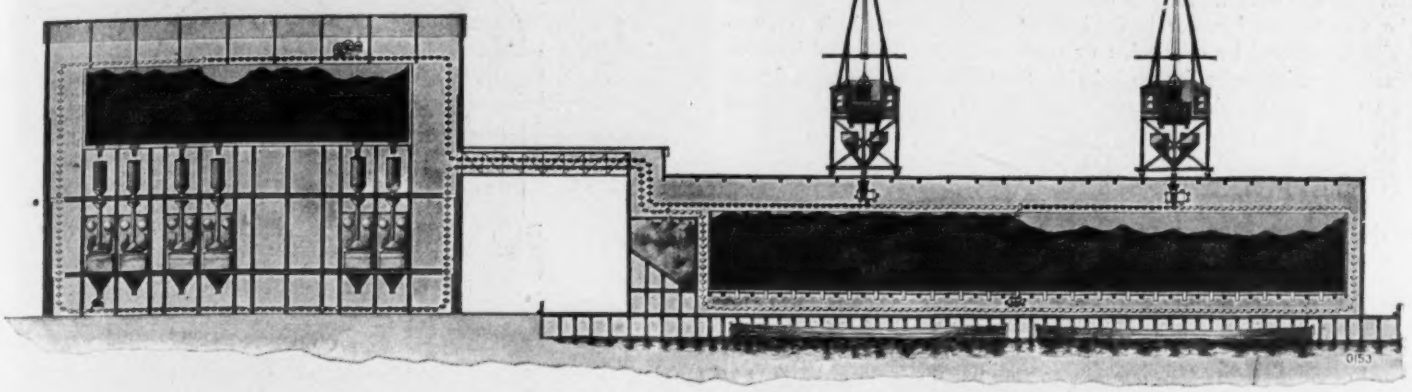


FIG. 1.—LONGITUDINAL SECTION OF COAL-HANDLING INSTALLATION.

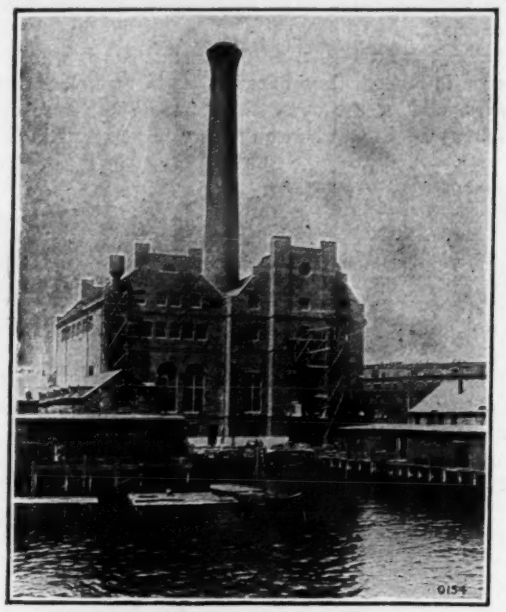


FIG. 2.—LINCOLN WHARF POWER STATION.

A Hunt rotary filler is used on the lower line for feeding the coal and ashes into the conveyor buckets. This filler measures a predetermined amount of material and deposits it in each passing bucket. The ashes are carried to a pocket on the wharf. The entire conveyor system is installed in duplicate, and is located in and extends the full length of the power house.

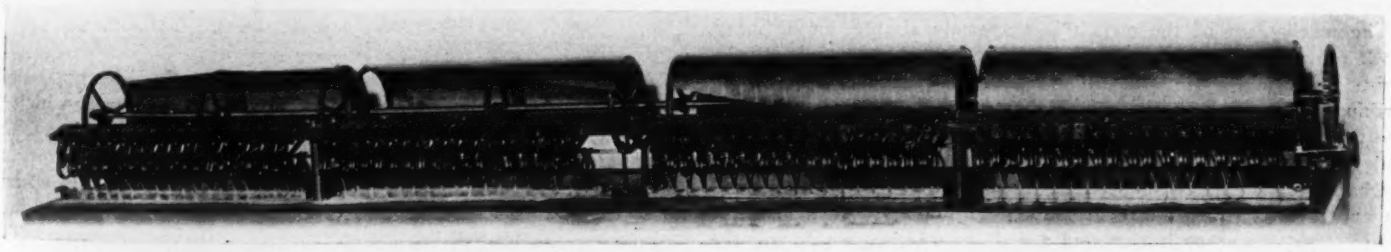
A New Departure in Electric Sign Flashers.

The Reynolds Electric Company, of Chicago, has recently built what appears to be the largest flasher (current controller or automatic switch) of the jack-knife pattern which has yet been constructed. This device is used to flash a very large electric sign erected by a prominent clothing firm in Boston. The letters in the sign are made in script style, containing 360 8-cp lamps. The lamps are wired in circuits of five lamps to a circuit, thus making 72 circuits, and are flashed or lighted so as to give the sign the appearance of being written out by an invisible hand, beginning with the first five lamps and continuing lighting each consecutive circuit of five lamps. This requires about 12 seconds, until the entire sign is illuminated. It remains a few seconds, then is extinguished. This operation is repeated about three times every minute, producing a most attractive effect.

The base of the flasher is 74 inches long by 12 inches wide. Instead of having one wheel or disk for each circuit as in the regular Reynolds flasher, a drum or cylinder of heavy brass is used, which is cut out diagonally, as shown, so that when revolving the various blades are forced one after the other into forks on the base. The lead wires from each circuit from each five lamps being attached to the bracket to which the blade is fastened, the illumination of the successive circuits in the sign is made perfectly uniform without the least interruption or break.

The drum of this device is entirely mechanical, and is not charged with electric current, the current passing only from the bar holding forks through the blade and blade-holder when contact is made, which makes it absolutely safe against burning. The device is driven with a one-tenth horse-power motor.

This is a departure from the former style of flashers for this type of signs, with a charged drum, as it was not considered advisable to construct an automatic rotary jack-knife switch on so large a scale. But all the difficulties have been overcome. We are informed that this firm is now making an estimate for a similar flasher, which is to be three times as large as this one. The company is equipped for manufacturing, besides the original Reynolds flasher of which there are thousands in use, anything in the line of flashing devices from the smallest to the largest, and makes a specialty of very large devices of this class.

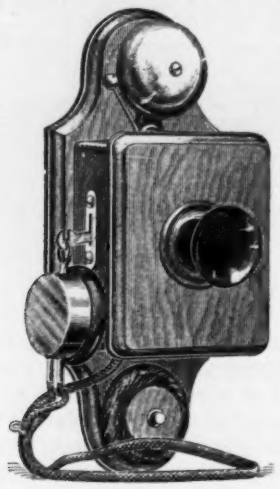


ELECTRIC SIGN FLASHER.

Telephone Station.

The accompanying cuts show a type of telephone station made by the West Electric Company, of Mount Vernon, N. Y., which has been designed to withstand the hard usage likely to occur at the hands of careless or incompetent persons. It will be seen by reference to the cut that the transmitter does not depend for its adjustment upon any part of the wood box, which is something that will be readily appreciated by those who understand the necessity of rigid construction in transmitter work.

The transmitters used are the finest obtainable, and in connection with specially treated granular carbon give the most gratifying results. The watch case receiver is double pole, of a type which is practically unaffected by expansion or contraction by reason of its construction, which embodies a steel ring-shaped casting having a thread cut on its outer end, by means of which the diaphragm is clamped



TELEPHONE STATION.

thereto. At the other end are arranged inner projecting lugs, on which are mounted soft Norway iron pole pieces. This construction gives a rigid, permanent adjustment.

The push button is the regular strap key, with the exception of being double; there are two sets of springs making contact in multiple, which reduces the possibility of leaving open circuits, as is so common when the old type of button is employed. It will also be noticed that there is an entire absence of binding posts on the instrument, contact washers being used for connection. This is a feature of decided merit, as it entirely obviates the possibility of loose contacts at binding posts which are more or less likely to give trouble. The hook switch is amply proportioned, and has German silver contact springs, which are kept bright by rubbing contact. The case is a polished oak box, making a very attractive appearance. A diagram of connections with directions is placed on the back of each instrument.

Electric Circuit Automatic Time Switch.

The automatic time switch shown in the accompanying illustration, known as the "Acme time switch," and manufactured by the Acme Switch Company, 84 Trumbull Street, Hartford, Conn., marks a distinct advance in switches of this type, and it is claimed that its practical success has been thoroughly demonstrated by service tests on central station circuits.

The mechanism of the switch is extremely simple, an ordinary clock movement being employed in connection with a few attachments which add a minimum of complication. On each side of the striking spring and on the same arbor are secured two disks, the one toward the face corresponding to the usual clock striking disk, and the one toward the back controlling the switch. The time mechanism has otherwise been changed merely so that the usual finger arbor shall make a complete revolution in 24 instead of 12 hours. On this arbor is mounted a disk on which are stamped the figures corresponding to the 24 hours of the day. Concentric with this disk are two pivoted arms, one of which is clamped at the hour when current is to be turned on the electric circuit and the other at the hour when current is to be cut off. As the disk revolves, at the time fixed a projection on one of these arms engages with an arm connected to the usual striking arrangement of a clock. The striking arrangement is then released, when the switch disk shown in Fig. 2, is instantly thrown over by the striking spring and the switch circuit closed. When the disengaging arm makes a similar contact with the striking release arm the disk is instantaneously thrown in the opposite direction and the circuit is opened.

Much mechanical skill is shown in the various details of the device. For example, instead of depending upon a clamping device to set the time tripping arrangement, a pin on the time arm enters a small hole at the periphery of the disk. The arm is of spring brass,

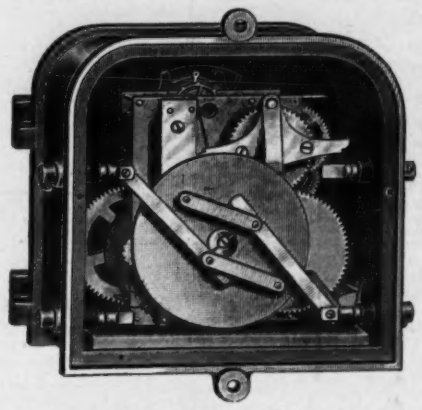


FIG. 1.—MECHANISM OF TIME SWITCH.

which enables it to be drawn back from the face of the disk sufficiently for the insertion of the pin in the selected hole. By this means it is obviously rendered impossible for the time device to become disengaged. The switch device at the rear has also been worked out along the most skillful mechanical lines, and is a model of simplicity. It gives an instantaneous break which is almost 2 inches long in the smaller sizes. The mechanism requires winding but once in seven days.

As will be seen from Fig. 1, all the mechanism is wholly enclosed when the case is locked, thus insuring against careless or incompetent employes, and at the same time making the case dust-proof. The switch may be inserted at any convenient point in the circuit,

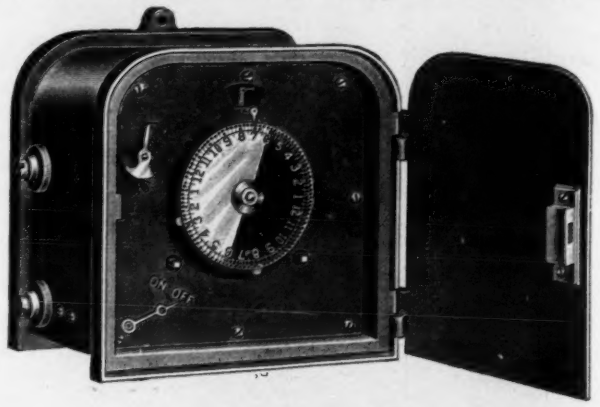


FIG. 2.—SWITCH DISK.

and is intended particularly for the control of interior arc and incandescent lamps and street arc lamps. The switch, which is made in sizes for a current of 15 to 50 amperes, has in the past few months been adopted by several large central stations for use on their circuits.

The Thompson Electric Automobile.

Andrew C. Thompson, of Plainfield, N. J., is manufacturing a light and high-powered electric automobile, illustrated herewith, which is claimed to have absolutely no parts that can get out of order. The running gear is of a special design, with solid axles. The motor and differential gear are mounted together in a strong steel frame, and gear direct to the hubs of the rear wheels. Extra strong 28-inch wire wheels and a ball-bearing steering apparatus are provided. The steering handle is fastened to the carriage body in such a manner as to do away with the vibration experienced in carriages having the steering handle fastened to the front axle.

The equipments are a combination volt-ammeter, electric light, a six-inch electric gong operated from a push button in the end of the

controller handle; an electric brake, and a powerful leather-lined band brake, which is operated by a foot lever and will bring the carriage to a standstill in a few feet when it is running at full speed. On applying the foot brake the power is disconnected, thereby obviating mistakes. Owing to the light weight, the vehicle is claimed to take but half the power to run it required by the average automobile, and also the cost of maintenance is reduced fully one-half.

ELECTRIC AUTOMOBILE.

Runabouts equipped with 20 cells of Porter battery weigh complete 550 lbs., and will run a carriage 25 miles on one charge at a maximum speed of 12 miles per hour. A Stanhope, when equipped with 40 cells of Porter battery, will run 75 miles on one charge, and weighs complete 900 lbs. The maximum speed is 20 miles per hour. The motor is of 2½ horse-power, capable of an overload of three times its rated power.

Coal Handling at Tacony, Pa.

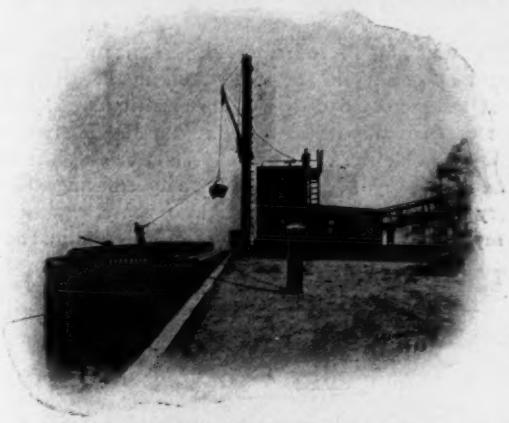


FIG. 1.—COAL HANDLING ON DOCK.

At the coal handling station erected for the Pennsylvania Manufacturing, Light & Power Company at Tacony, Philadelphia, coal is delivered either from Delaware River boats or railroad cars to the pocket of 1000 tons storage capacity. The horizontal conveyor over the pocket is reversible and distributes coal delivered either by an inclined conveyor from the dock or by a vertical elevator from railroad cars. The capacity of the plant is 40 tons per hour from railroad cars and 25 tons per hour from river boats. Facilities are provided for crushing the coal at each end, and the entire plant is motor driven. This equipment was furnished by the Link-Belt Engineering Company, of Nicetown, Philadelphia. The local lighting company using it is the consolidation of the various companies of Philadelphia, on the same lines as in New York and Chicago, aiming at a massing together of generating capacity and a consequent economical production of current. In the illustrations herewith, Fig. 1 shows the tub hoist unloading coal from boats and delivering it to the inclined conveyor. Fig. 2 is a sectional view of the whole equipment. Fig. 3 shows the reversible suspended flight conveyor receiving at either end and delivering to such a point in the pocket below, as may be determined. Fig. 4 is a general view of the pocket seen in section in Fig. 2, which are so clear as to need virtually no explanation.

FIG. 3.—REVERSIBLE SUSPENDED FLIGHT CONVEYOR.

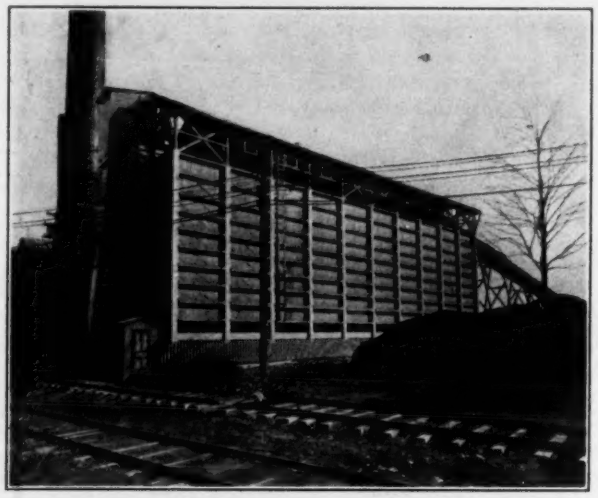


FIG. 4.—GENERAL VIEW OF POCKET.

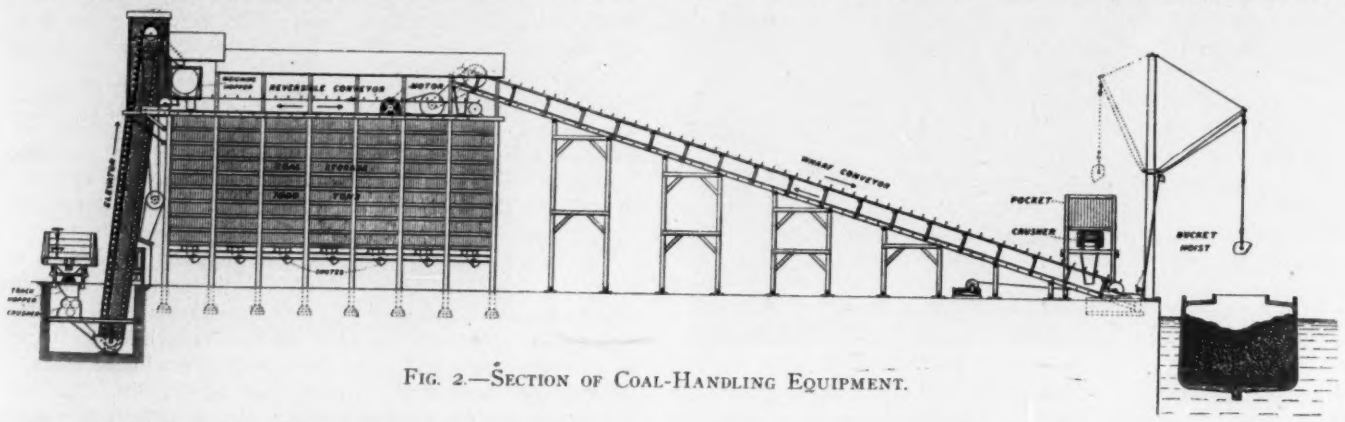
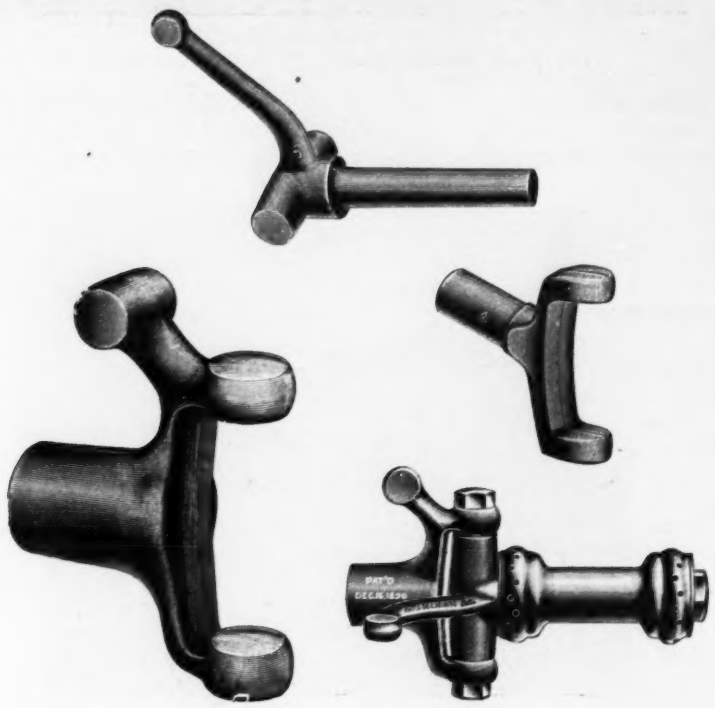


FIG. 2.—SECTION OF COAL-HANDLING EQUIPMENT.

Drop Forgings for Automobiles.

In considering the question of the advisability of the use of drop-forgings for automobile parts by the manufacturer, the desirability is unquestioned as compared with parts and fittings made by any other method. The great obstacle is the cost of necessary dies and tools required to produce these forgings. If the vehicle is in the experimental stage, it is undoubtedly advisable to use castings, as they can be produced cheaply, and if changes are required, the alteration or making of new patterns is comparatively inexpensive. But when the vehicle has outgrown this experimental stage and is ready to be manufactured in fair quantities for the market, then comes the opportunity for the profitable use of drop-forgings. First, because on account of larger quantities, the maker can produce them at less cost; second, because they are less expensive than castings to machine and finish; and, last, but not least, the motor vehicle manufacturer cannot afford to use anything but the strongest, toughest and best material in his product, for the vehicle is now going to be put into the hands of a more or less uneducated public, as regards machinery, which will have no mercy for a weak joint or faulty construction.

It is evident that the makers of drop-forgings are alive to the possibilities of the use of their product in the automobile field, and show an inclination to promote the use of standard parts as far as possible. This is now a recognized condition of the cycle trade. It is



DROP FORGINGS FOR AUTOMOBILES.

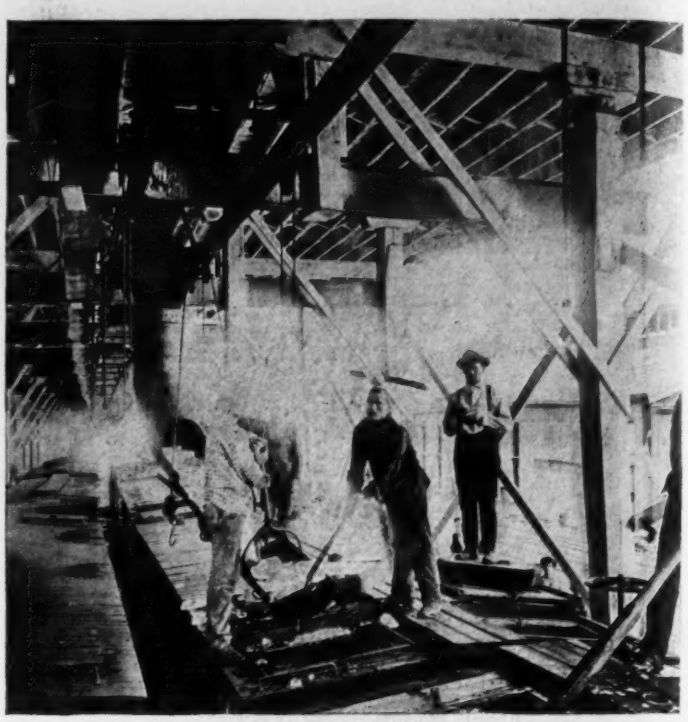
not, however, possible to create a line of standard parts of any extent at this time, owing to the unlimited variety of styles and designs of running gear, etc.

Various sizes of front axle ends and steering knuckles seem to be about the only parts that are safe for a maker to stock up on at this time, and the Billings & Spencer Company, of Hartford, also well known already to electrical manufacturers, is taking a lead in this direction. These parts are protected by patent, and made under license.

The steering knuckle and axle end shown is machined and fitted with a special ball-bearing automobile hub. The bearings are fitted with hardened and ground tool steel cups and cones, and have a positive adjustment that can be worked by removing the dust cap. The hubs are drilled for either straight or tangent spokes, and are fitted with felt and leather washers, also with dust caps. The upper end of the hub of the steering knuckle works on a fiber washer. The drilling of the eye in the arm of the steering knuckle and the drilling for the axle and of the spring lug in the axle end are left blank. This steering equipment is suitable for carriages weighing up to 1600 lbs. without passengers.

Icing Refrigerator Cars.

The illustration shown herewith affords an interesting idea as to the ingenious manner in which perishable food is refrigerated for transit on American railroads. The view is taken in the Armour icing plant, Kansas City, and represents the method devised by the Jeffrey Manufacturing Company, of Columbus, Ohio, for delivering ice to the refrigerator cars. The conveyor is supported over the cars. The ice which has been broken or crushed before it enters the conveyors is carried along by a system of flights attached to chains, to



ICE CONVEYOR.

the point where the revolving chute is located. The ice passes from this revolving spout by gravity to the ice pockets in the cars. The system is driven at the factory end by a 25-hp electric motor, and is probably the most extensive of its kind in the world. The connections are arranged to enable the icing crew to start or stop the conveyor at will. The ice conveyor has a large capacity, sufficing to ice a whole car in a very few minutes, and at a slight expense.

The steel conveyor is an important feature of this outfit, and is of such proportion as to insure reliable and satisfactory operation.

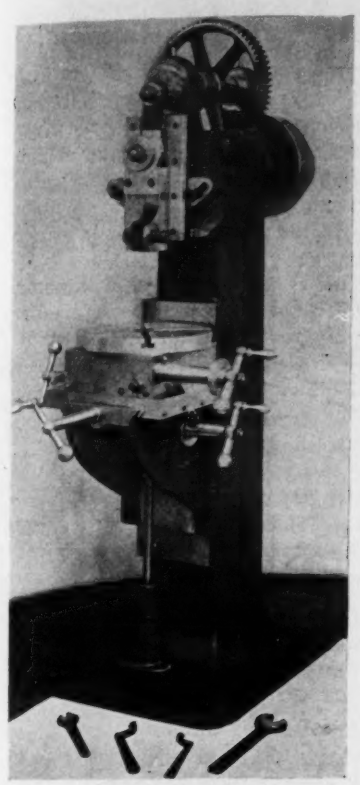
A Small Die Slotter.

A small machine tool, which is to be found in a great many American electrical shops, is the die slotter shown herewith, made by the Garvin Machine Company, of Spring and Varick Streets, New York City. This tool has been found highly suitable for all die work, small key seating, both straight and taper; also internal or external gear patterns, where draft is required, and all that class of common slotting.

The two cross motions and the rotary table provide for following any outline. The handle for the rotary table is arranged for using dials for dividing purposes, but for small divisions and rapid work it may be entirely removed, and the table revolved by hand, using the lock-pin device, which provides 12 divisions for square, hexagon, octagon, duo-decagon, etc.

The stroke of the machine has been fixed at 2½ inches, which is ample for this class of work for which the machine is intended, and affords greater strength than an adjustable pin. The speed can be changed by means of the cone pulley. The slide for the ram can be swiveled 5 degs. either way, and set by a graduated index, thereby insuring the same draft to every part of the die. The tool block is well adapted for holding special tools. It swivels in a center near its lower end, and at the upper end, carried in a yoke, are two hard-

ened plugs which bear on a cam that is bushed into the lower end of the connecting rod, and from it derives a partially rotary motion,



DIE SLOTTER.

thus locking the tool block on the down stroke and causing the tool to clear on the up stroke. Among the shops where the tool is in use may be mentioned those of the Westinghouse and General Electric Companies.

Panel Board with Removable Enclosed Fuse Carrier.

The accompanying illustrations show a new type of enclosed fuse carrier and panel board, which are being placed upon the market by

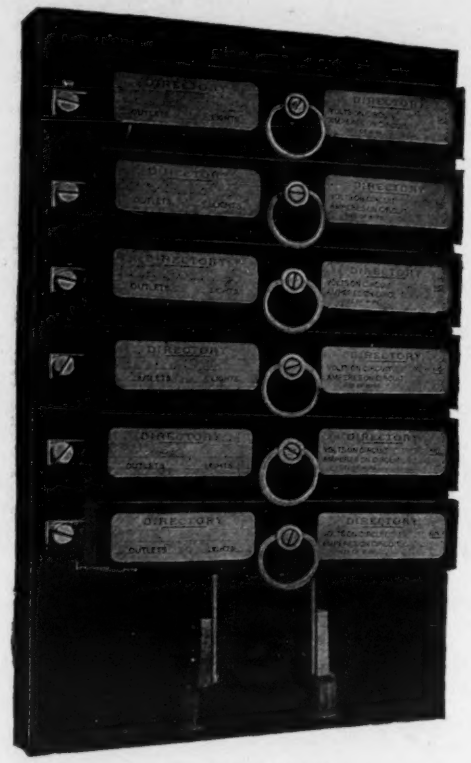


FIG. 1.—PANEL BOARD.

the General Incandescent Arc Light Company, of New York. Fig. 1 shows a panel board for six circuits on a two-wire main, and Fig. 2 a combined switch and enclosed fuse carrier, the latter being installed on the board of Fig. 1. It will be seen that the fuse carrier of Fig. 2 includes the functions of a knife switch, a removable fuse holder and an enclosed fuse. To use the carrier as a switch it is merely pulled out by means of the ring handle shown, upon which the circuit is opened. To renew a fuse the carrier is removed by simply taking out a screw, thus enabling a new fuse to be inserted in the most convenient position away from the panel, thus obviating the risk of short-circuits or other trouble through the use of a screw-driver near a live circuit.

Each fuse carrier is designed to receive a directory card on which

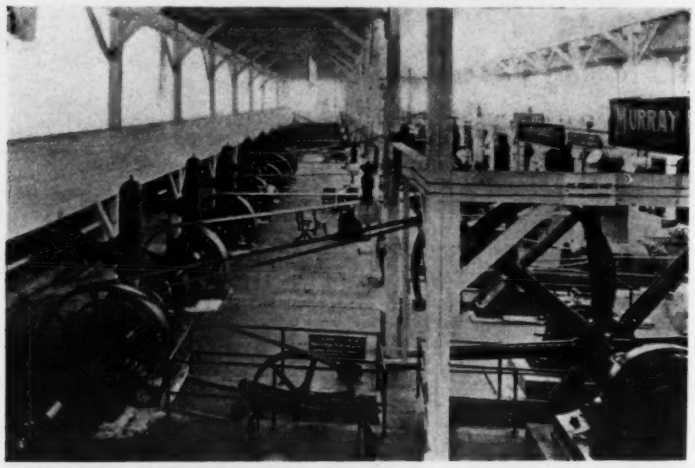
FIG. 2.—COMBINED SWITCH AND ENCLOSED FUSE CARRIER.

can be written, under properly printed headings, the number of outlets, lights and locations, the size of wire, the amperes and volts. This information being labeled directly at the point where the circuit is controlled is obviously more convenient than the present method of placing directory frames on the doors of the panel boxes.

The carriers are designed for a capacity of 10 amperes and 125 volts, and the main feed bus-bars are figured to carry 6 amperes per circuit.

Arc Lighting at the Pan-American.

At the Pan-American Exposition the functions of the arc and the incandescent lamp appear to have been curiously reversed. The incandescent lamp is gloriously conspicuous outdoors, while indoors there is a notably large use of the arc lamp. The C. J. Toerring Company, of Philadelphia, has quite a large display of its well-known arc lamps, for example. Its exhibit proper is with that of the D'Olier Engineering Company, of Philadelphia, as shown. Beyond that, it has 30 lamps used for lighting the Court of the Machinery Building, where the water for the fountain is pumped, and some of

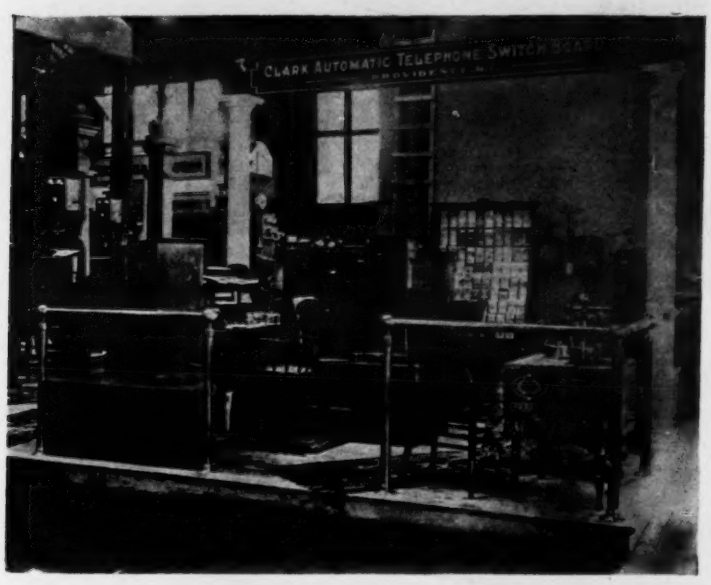


ARC LIGHTING IN MACHINERY BUILDING.

the current for the lighting of the grounds is generated. The Graphic Arts Building is also lighted by 20 more Toerring lamps.

Exhibit of Automatic Telephone Apparatus.

Electricity Building at the Pan-American Exhibition includes among its exhibits a remarkably large proportion of telephone apparatus; in fact, it is said that it is the most varied and complete display of the kind ever made in this country. One of these noteworthy telephone exhibits is that of the Clark Automatic Telephone



AUTOMATIC TELEPHONE EXHIBIT.

Switchboard Company, of Providence, R. I., and the apparatus is attracting considerable attention from its ingenuity, neatness and excellent construction. The company has installed the switchboards having capacities of 12, 24, 48 and 72 Clark automatic switches, as well as samples of its different types of wall and desk telephones. One of the boards is wired up to the wall and desk instruments in order to illustrate practically the operation of the Clark system. As thus shown, the system, which is obviously both simple and durable, is designed for use in small towns, mills, factories, warehouses, etc., the present capacity being 76 subscribers or stations. This number can, however, be readily doubled, but the smaller number covers a vast range of demand, and the company shows orders and plants not only all over this country, but for the far ends of the earth.

The E. G. Bernard Company at the Pan-American.

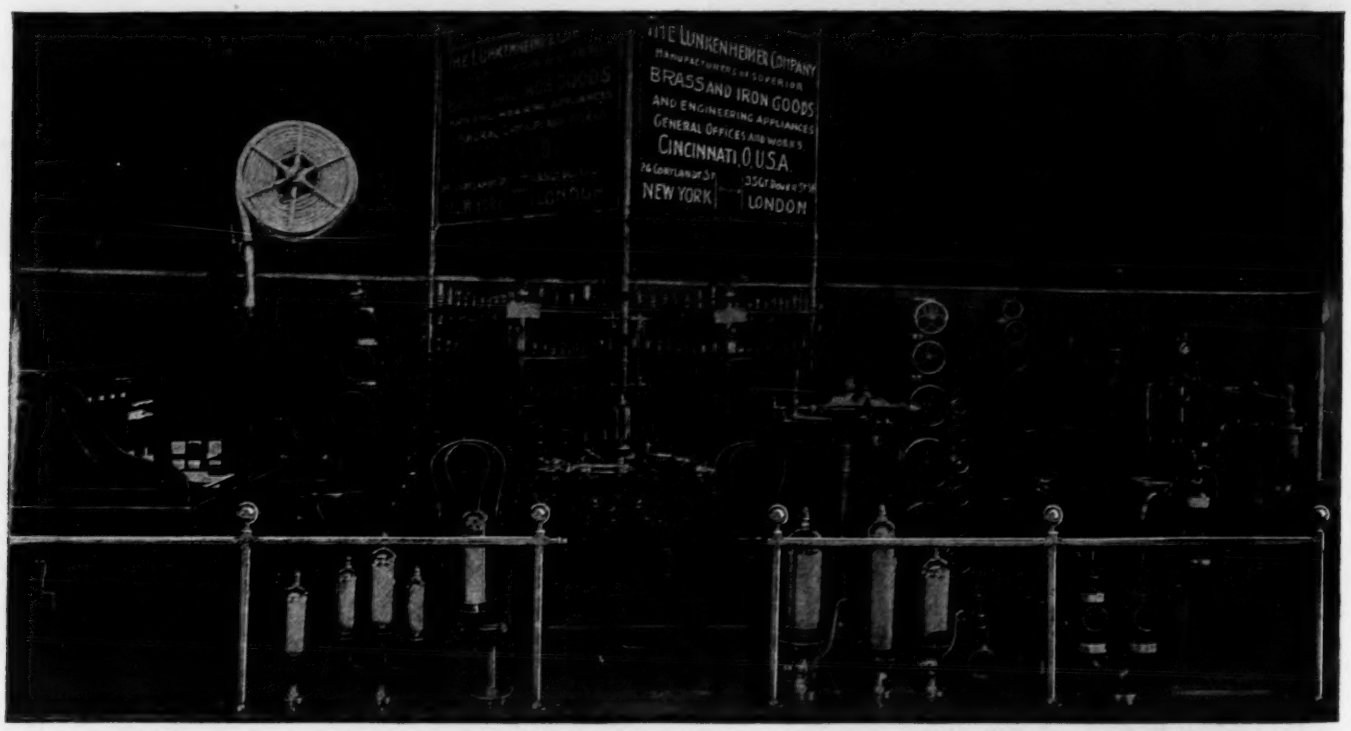
The E. G. Bernard Company, of Troy, N. Y., occupies a building on the west side of North Bay, a short distance south of the New York State Building. Here is located the motor generator which transforms the 500-volt current of the Exposition power service to 110-volt current for use in the searchlights of the electric fountain located in the middle of North Bay. This motor generator is loaned the Exposition by the Bernard Company.

The main motor generator set consists of a 130-hp, 500-volt motor, direct connected to a 125-volt, 680-ampere generator. A smaller motor-generator consisting of a 3-hp, 500-volt motor driving a 125-volt, 12-ampere dynamo supplies current for the arc and incandescent lights in and around the building. Each set has a separate switchboard panel equipped with Whitney ammeters and voltmeters, circuit breakers, rheostats and controlling switches.

Adjoining the dynamo room the company has fitted up a reception room for the entertainment of guests, and also exhibits a 9-kw multipolar generator. The E. G. Bernard Company's building is headquarters for its customers, and the company is keeping "open house" for electrical men and others when they wander down to that part of the grounds.

Exhibit of Steam and Engineering Specialties.

One of the handsomest, most complete and interesting exhibits at the Pan-American Exposition is that of the Lunkenheimer Company, installed in the Machinery and Transportation Building. Visitors to the Exposition who are interested in brass and iron steam specialties and engineering appliances find much to occupy their attention in it. Mr. F. L. Swanberg is in charge. There can be seen a complete line of regrinding valves, handy valves, lever throttle



Steam and Engineering Specialties at the Pan-American.

valves, pop safety valves, plain whistles, chime whistles, fire alarm whistles, injectors, sight-feed lubricators, oil cups, grease cups, glass cups, glass body oil pumps and a complete line of brass valves and fittings for marine work in medium and extra heavy patterns. The "Lukenheimer" specialties, such as are shown here, were awarded three highest medals at the Exposition Universelle, Paris, 1900. The headquarters of the Lunkenheimer Company are in Cincinnati, and they have branches in New York and London.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money is nominal, at quotations ranging between 2 and 3 per cent. Time money is quoted at 4½ per cent for 60 to 90 days, and 5 per cent for four, five and six months. Mercantile paper closed at 4½@5 per cent for 60 to 90 days' indorsements; 5@5½ for choice four to six months' single names, and 5½@6 for others. In the stock market, speculation was extremely dull, mainly in consequence of the closing of the exchange from last Friday to Tuesday of this week. Stock values are steady at slight reaction from the recent advances. The strength of the steel stocks was a prominent feature of the market. Other industrial stocks were somewhat neglected. Amalgamated Copper rose to 122¾ on further reports that a big combination was on foot among copper producers, and that the dividends on the stock might be increased. Tractions were weak and little trading was done. Brooklyn Rapid Transit fluctuated between 74⅞ and 77⅜, closing the week with a net loss of 1⅝ points, the sales being 14,630 shares. Metropolitan Street Railway lost ⅞ of a point, net, at the close, the range of prices during the week being between 167¼ and 170, the sales being only 1950 shares. General Electric closed with a net gain of 2¼ points, although the trading was limited to 900 shares for the week. There was a wide range of prices, the extremes being 255 and 268. Western Union closed with a net gain of ½ point, on sales of 9170 shares. Following are the closing quotations on Tuesday, Sept. 3:

NEW YORK.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
American Tel. & Cable...	—	—	General Carriage.....	¾	½
American Dist. Tel.....	—	—	Hudson River Tel.....	120	120
Brooklyn Rapid Transit..	75¼	75	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry...	167¼	167½
Electric Boat.....	19	23	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	48	48	N. Y. Elec. Veh. Tran...	10½	10½
Electric Lead Reduc'n...	1½	1½	N. Y. & N. J. Tel.....	168	168
Electric Vehicle.....	5	5¼	Tel. & Tel. Co. of Am....	3	5
Electric Vehicle pfd.....	10	10	Western Union Tel.....	93	93⅛
General Electric.....	265½	267½			

BOSTON.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
Am. Tel. & Tel.....	164½	166	Mexican Telephone.....	2½	2½
Cumberland Telephone...	—	—	New England Telephone..	—	—
Boston Electric Light....	250	250	Westinghouse Elec.....	—	—
Erie Telephone.....	45	42	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
American Railways.....	40	40¾	Phila. Traction.....	97½	97½
Electric Storage Battery..	74	72	Philadelphia Electric....	5⅜	6
Elec. Storage Batt'y pfd..	74	72	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America.....	7⅜	7⅜	Pa. Elec. Veh. pfd.....	¾	¾

CHICAGO.

	Aug. 27.	Sept. 3.		Aug. 27.	Sept. 3.
Central Union Telephone..	—	—	National Carbon pfd.....	84	—
Chicago Edison.....	162½	—	Northwest Elev. com....	38	—
Chicago City Ry.....	209	206	Union Traction.....	17⅜	—
Chicago Telep. Co.....	268	—	Union Traction pfd.....	60	—
National Carbon.....	17	18			

TELEPHONE, TELEGRAPH & CABLE COMPANY.—A circular has been sent to the stockholders of the Telephone, Telegraph & Cable Company of America which states that a proposition has been received from C. W. Morse to purchase the holdings of each stockholder at 50 per cent of the amount each has paid in. The purchase is conditional upon at least two-thirds of the total number of shares being delivered to the City Trust Company before Sept. 10. The circular states that the board of directors, realizing the need of large sums of money to put the company in operation, and as a large number of the stockholders are unwilling to advance additional funds, recommends the acceptance of Mr. Morse's offer. As the amount paid in thus far is about $4,000,000, Mr. Morse's offer will involve the payment of about $2,000,000. Mr. Morse says that he is assuming the responsibility of the purchase as an individual. Mr. Morse is known in financial and political circles as the head of the American Ice Company, of New York, and is said to have friendly relations with Tammany leaders.

GENERAL ELECTRIC.—The amount of stock which it would be necessary to issue ultimately in order to return to the stockholders the scaling down of July, 1898, would be 66⅔ per cent of their present holdings, say, about $16,500,000 new stock, assuming all debentures and preferred stock to be exchanged into common stock. In any stock distribution only such an amount of stock can be actually issued as is equaled by the actual surplus of the company. This surplus on Jan. 31 last stood at $6,629,180, having been increased $4,276,150 in the operations of the company for the year ended Jan. 31, 1901. It would, of course, be within the province of the directors, whenever they deemed such a course safe, to recommend to the shareholders such an issue of new shares as would be warranted by the condition of the surplus, even should such division not wholly complete the restoration mentioned above.

DIVIDENDS.—The Chicago City Railway Company has declared a dividend of 2¼ per cent on the increased stock, payable on Sept. 30. While this is at the rate of 9 per cent a year it is understood that no decision has been reached as to the permanent rate of dividend on the stock. At the 9 per cent rate the dividend requirements are $1,620,000, or precisely what they were when 12 per cent was paid on the old stock. When on July 1 the stock was increased from $13,500,000 to $18,000,000, the proceeds of the new issue were used to retire $4,610,500 of 4½ bonds which matured on that date. The company has this saving of interest, and can easily pay 10 per cent on its stock unless it has decided to save up a cash surplus. The Southern Ohio Traction Company has declared a ¾ per cent dividend, payable Sept. 1.

PURCHASE OF PROPERTIES.—The Minneapolis General Electric Company has gained control of the International Electric Company by a purchase of its bonds. The American Light & Traction Company, of which Emerson McMillin is president, has bought the Binghamton, N. Y., Gas Company.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a further enlargement of general trade distribution and a more cheerful tone, due to various causes, chief of which were better corn crop advices, confidence in the early termination of the steel strike, a further advance in cotton, and the advent of cooler weather. In the iron and steel trades there is a much stronger feeling of confidence as to the early settlement of the strikes in those lines, business being in good shape and consumption large. Finished products are still bringing high premiums. Structural material, plate and bar mills have orders for months ahead. Gross railway earnings maintain their previous gains on 53 roads for the third week of August, aggregating $10,161,692, a gain of 12 per cent over the corresponding week last year. The business failures for the week, as reported by *Bradstreet's*, were 188, against 181, the week previous, and 165 the same week last year. In the metal market there was considerable activity in copper both in the home and in foreign markets. The home consumption is very heavy, and abroad the market appears to be improving. Prices at home remain unchanged, however, Lake being quoted at 16½ cents; electrolytic in cakes, bars or ingots, 16¼ cents; cathodes, 16 cents; casting copper, 15⅞ cents.

CITY OF MEXICO STREET RAILWAY.—Advices just to hand from the Mexican capital state that work on an extension of the lines of the Compania Limitada de Tranvias de Mexico to the suburb of Tacuba will be commenced immediately after the consent of the Mexican Government is given to the project. Such sanction, it is anticipated, will be secured within the next week. Mr. A. E. Worwick, the resident manager of the Mexican system, which is controlled by the well-known Anglo-African financial house of Wernher Beit & Co., is expected to return next week from his visit to London, and it is believed that during his stay in New York he will make arrangements for the purchase of the material, etc., required. Mr. Worwick, while in New York, it is said, will stay at the Holland House.

INSTRUMENTS FOR THE GOVERNMENT.—Mr. James G. Biddle, Stephen Girard Building, Philadelphia, has recently taken some important orders from the United States Signal Corps, Washington, D. C., including one Anthony type standard resistance box, and Wheatstone bridge, one conductivity bridge with accessory apparatus, D'Arsonval galvanometers, portable testing sets, and a large number of portable testing magnetos and Weston portable voltmeters. All of the apparatus, with the exception of the magnetos and Weston voltmeters, was made by Morris E. Leeds & Co.

AUTOMATIC TELEPHONE CONTRACT.—The Clark Automatic Telephone Switchboard Company, Banigan Building, Providence, R. I., have just executed a contract for a 9-point system in the works of the Semet-Solvay Company, at Ensley, Ala. This neat little telephone plant included considerable outside construction, and is scattered over a wide area, thus illustrating very forcibly the adaptability of the Clark automatic apparatus and system for such industrial plants.

THE C & C ELECTRIC COMPANY reports that it is experiencing a most gratifying demand for its product, and is daily making some unusually nice sales. It expects very shortly to have to largely increase its force. Among the more interesting of its sales during the last month we mention the following: Its series-parallel equipments for driving large printing presses are becoming popular, and it now has orders for one 30-hp equipment for the *Peoria Star*, one 50-hp equipment for the *Milwaukee Free Press*, and one 15-hp equipment for the Chester, Pa., *Times*. Among the orders for generators the most interesting are for one 50-kw and one 25-kw engine type generators for the Stafford apartment house, Philadelphia; two 100-kw and one 50-kw engine type generators, besides quite a number of small motors for the Kirchbaum Building, owned by John Wanamaker, of Philadelphia. For the same customer they have just shipped a 75-kw engine type generator, to be followed by two 10-hp and two 15-hp motors. They are building a 20-kw belt type generator and switchboard and 15-hp electric hoist for the International Phosphate Company, of Carteret, N. J. They are building two 60-kw engine type generators for the Brooklyn Bridge, and are installing for the Dewey Warehouse, New York, a complete lighting and power transmission plant with wiring, consisting of an 85-kw belt type generator, handsome switchboard, and 50 horse-power in motors of various sizes. An 85-kw belted generator is also being built for the Eagle Pencil Company, of New York. The United States Watch Case Company, of Riverside, N. J., has ordered two 40-kw generators and four small motors. The Wolf Company, of Chambersburg, Pa., has ordered a 100-kw belted generator and a 105-hp motor. For the Bartlett Building, Atlantic City, they are building one 50-kw and one 75-kw engine type generators. For driving the ventilating blowers in the new Mt. Sinai Hospital, New York, 10 motors ranging in size from 1½ to 20 horse-power will be furnished. They are also furnishing about an equal number of motors for driving the exhaust fans in the same building.

FOREIGN AND DOMESTIC ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., have recently secured orders for a 50-hp standard simple engine, which is to be direct connected to a 30-kw generator of General Electric make for installation in an electric light station at Vera Cruz, Mexico. Another Mexican order lately received was for a 50-hp tandem compound engine. The contracts obtained by the Harrisburg people within the past two weeks are reported to have been especially numerous. The principal ones include orders from the Otis Elevator Company, of Yonkers, N. Y., for two tandem compound, high-speed engines, one of 300 horse-power and the other of 200 horse-power, to be direct connected to generators of 200 kilowatts and 125 kilowatts, respectively, manufactured by the Crocker-Wheeler Company. The Union Club, Fifty-first Street and Fifth Avenue, New York City, is to have installed three 75-hp Harrisburg standard simple engines, direct connected each to a 50-kw generator built by the General Electric Company. A 120-hp standard simple engine has been ordered by the American Agricultural & Chemical Company, Baltimore, Md. This engine is intended to be direct connected to a 75-kw generator of General Electric make. The Teachers' College, 120th Street, has requisitioned for a 200-hp standard simple engine, to be direct connected to a 125-kw General Electric generator. A four-valve belted engine of 150 horse-power has been called for by the Clotx Throwing Company, of Scranton, Pa., which will be belted to shafting. All these contracts were closed through the New York representative of the Harrisburg Foundry & Machine Works, Mr. W. P. McKenzie, whose offices are in the Mail and Express Building, 203 Broadway.

CONTRACTS FOR TOKIO TRACTION SYSTEM.—Chief engineer Enyo, of the Tokio Deusha Tetsudo Company, Japan, who has been in the United States for some time past for the purpose of securing quotations from American concerns for the equipment of the company's projected electric traction system, has just dispatched all the necessary data to his directors in Japan, and it is expected that confirmation as to the purchase of American equipment will be received by cable within the next 30 days. The General Electric Company, it is stated, has submitted a proposition for the equipment of the projected road. The Tokio Company's system will be double tracked, and 12 miles in length. Three hundred cars will be utilized on commencing operations. While car bodies, owing to the cheapness of wood in Japan, will be manufactured there, the requisite trucks and motor equipments will be purchased in the United States. Close on $1,000,000 will be expended in the initial equipment of the road. The generating plant will have a capacity of 4000 horse-power. About 2500 tons of rails will be utilized. As the Tokio company, in view of the monetary stringency at present existing in Japan, is desirous of obtaining an extended credit for its purchases here, financial arrangements, it is said, have been made through the Japanese banking house of Mitsui & Co., whose New York offices are at 445-7 Broome Street, for the handling of the deal. Mr. Eyno intends to remain here for several months to attend to the several details in connection with the completion of the contracts. Mr. Enyo can be reached through Mitsui & Co., or at the offices in the Havemeyer Building, of McIntosh, Seymour & Co.

ELECTRICAL EQUIPMENT IN PORTO RICO.—The South Porto Rico Sugar Company, which was recently organized with a capital of $3,000,000, is considering the advisability of adopting electricity somewhat extensively in its sugar factory. It is anticipated that everything outside the mills and crushers will be driven by electric motors. Mr. Hugh Kelly, the well-known sugar plantation expert of 71 Wall Street, New York City, is now designing the sugar factory. Its equipment will entail an expenditure of not far short of $1,000,000. The company has secured some 4000 acres of sugar lands near Guanica, on the south coast of Porto Rico. The sugar factory will have a capacity for handling 1600 tons of cane per day, and is to be capable of annually manufacturing 16,000 tons of sugar. Everything in the way of material, equipment, etc., will be purchased in the United States, with the exception of a few articles, of special machinery not manufactured by American concerns. In addition to the sugar plant contracts, a considerable quantity of steel rails and rolling stock will be ordered. A dock will also be constructed in the harbor of Guanica. The company's offices are at 44 Wall Street. Mr. William Schall, Jr., of Muller, Schall & Co., bankers, 44 Wall Street, is the president of the company. Mr. E. Pavenstedt, of the same financial house, is treasurer. Mr. Frank A. Dillingham is secretary. The plant is expected to be in full working operation by December, 1902.

ORDERS FOR TELEPHONE PLANT.—The Haines & Noyes Company, Chicago, through its private telephone department, has closed the following large contracts: The Tampa Electric Company, Tampa, Fla., a complete telephone system for the Tampa Electric Railway. This order was closed with Stone & Webster, Boston. A private telephone plant for the large publishing house of David C. Cook & Co., Elgin, Ill.; a complete central energy telephone plant for the new factory of the Storey & Clark Piano Company, Grand Haven, Mich.; A complete private telephone plant for the new Wesley Hospital, Chicago, through the Arthur Frantzen Company, Chicago; a private telephone plant for the Chicago branch of the Pabst Brewing Company; the College of Physicians and Surgeons, Chicago, for a large plant through the Arthur Frantzen Company, Chicago. The Haines & Noyes Company is also closing a great many contracts for apartments, and in the last two weeks it has closed five contracts for apartments in Chicago alone. It has recently shipped a large consignment of telephones to St. Johns, N. B., and to Skagway, Alaska. It reports an increasing business, and is enlarging its factory. It has just closed a contract with Roak & Rittenhouse to represent it in Philadelphia.

NEW YORK EXPRESS DELIVERY CARS.—The Metropolitan Express Company, of New York City, which operates suburban express service over the lines of the Metropolitan Street Railway Company, is in the market for 25 express cars. They will be equipped with the overhead trolley, underground electric and storage-battery systems. It has been slow work starting this urban railway express system, and rivals declare that it cannot succeed. The company's intention of putting more cars in service is taken as indicative of something different.

MAXWELL M. MAYER ELECTRIC COMPANY, of 42 Cortlandt Street, New York City, reports the following orders: Grinberg Brothers, New York, one 1-hp, two 2-hp, one 3-hp and one 4-hp motors; Crescent Gas Fixture & Art Metal Company, Bridgeton, N. J., one 100-ampere plating dynamo; also one 75-light compound-wound dynamo for Pueblo, Mexico, and a 1000-ampere plating dynamo for Montreal, Canada.

BRILL CAR MATERIAL FOR SPAIN AND GERMANY.—The J. G. Brill Company, of Philadelphia, is about to make shipment of 32 pairs of wheels on axles for the Barcelona electric traction system, also fair-sized lots of car material to Bilbao, Spain, and Neuhausen, Germany.

BALL ENGINE SALES.—The C. Reiss Coal Company, of Sheboygan, Wis., is equipping its coal docks with electricity. A 350-hp Ball engine, direct connected to a Milwaukee generator, furnishes the power. St. Mary's Hospital, Philadelphia, is being equipped with an electric plant. The Ball Engine Company will furnish the engines.

APPARATUS WANTED FOR TEXAS.—Mr. C. P. Dodge, State Purchasing Agent, Austin, Texas, is in the market for a direct-coupled, three-phase generator, 90 kilowatts, voltage 125, speed 270 revolutions, together with switchboard, etc., and a 4-ported automatic high-speed engine, vertical preferred, of corresponding capacity.

MR. ELMER P. MORRIS, treasurer of the Morris Electric Company, of 15 Cortlandt Street, New York City, has just returned from a short trip to Cuba, where he has been the guest of General Manager Greenwood, of the Havana Electric Railway Company.

MACHINERY EXHIBITION IN PERU.—At the machinery exhibition, Lima, Peru, the Westinghouse Electric & Manufacturing Company is one of the chief exhibitors to secure awards.

FOREIGN ORDERS FOR AMERICAN ELECTRIC ELEVATORS.—The Otis Elevator Company reports a rapidly increasing foreign demand for electric elevators for both passenger and freight purposes, also dinner elevators. The chief markets at present are in Great Britain and Germany, notwithstanding that these two countries present the strongest competition on the part of domestic manufacturers. Belgium, Spain, Hungary and South America also are steadily showing a preference for American elevators. The Otis people have just secured through their London interests a contract calling for the installation of electric elevators in Buckingham Palace, London. The contract provides for two electric passenger elevators, one of which is intended for the Royal Privy Purse Department, one electric baggage "lift," and one electric dinner elevator to connect with the State dining hall. The contract was secured in the face of the severest British competition. The American elevators will take the place of the old hand power "lifts" which were installed in the Royal Palace during the late Queen's reign. The elevators will be furnished with all the very latest American improvements and contrivances. They are to be operated by push buttons. An electric dinner waiter apparatus has also been ordered for the Royal Castle at Windsor, and the Duke and Duchess of York's London residence, Clarence House, is to be equipped with an Otis electric luggage "lift." Other royal orders recently awarded to the Otis Company include one for two electric passenger elevators for the Royal Palace at Budapest, Hungary. Miscellaneous contracts lately in hand from Europe comprise one electric passenger, one electric luggage and two electric dinner "lifts" for Andrew Carnegie's Scotch residence, Skibo Castle; A. Stavenow, Berlin, Germany, four electric passenger and two freight elevators; Hotel Bristol, Warsaw, Poland, three electric passenger, two freight and six dinner "lifts"; Grand Hotel, Brussels, two electric passenger and one electric luggage elevators; Hotel Metropole, Brussels, two electric passenger and two dinner "lifts"; Hotel de l'Europe and Hotel de Volder, Brussels, one electric passenger elevator each; Hotel de Globe, Ostend, Belgium, one electric passenger elevator; Deutsche Bank, Munich, Bavaria, two electric passenger elevators, and A. B. Sperlingensbache, Stockholm, Sweden, two electric freight elevators. Australian orders secured within the last few weeks include one for an electric freight elevator, which will be shipped to Felton, Grinwade & Co., of Perth, Western Australia. Nearer home, the Lake Superior Power Company, Sault Ste. Marie, Ont., has called for two electric hoisting engines of very large capacity. The South American Electric Company has requisitioned for three electric passenger elevators for Buenos Ayres, while an electric passenger elevator has also been ordered for installation in the Treasury Building at Havana.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended Aug. 22, 1901: Antwerp—83 packages electrical material, $3,761; 24 packages electrical machinery, $241. Argentine Republic—14 cases electrical material, $4,250. Arnheim—1 case motor vehicle, $130. British Guiana—6 packages electrical material, $345. Brazil—126 packages electrical material, $1,776. British West Indies—4 packages electrical material, $357. Bremen—18 packages electrical goods, $569. British East Indies—3 packages electrical material, $59. Berlin—3 cases electrical machinery, $50; 2 packages electrical material, $215. Bristol—1 package electrical machinery, $50. All other British Possessions—37 packages electrical material, $693. Brussels—12 cases electrical material, $600. British Africa—41 cases electrical material, $2,926. Central America—34 packages electrical material, $455; 1 roll cable, $700. Cuba—72 cases electrical machinery, $3,510; 76 cases electrical material, $3,144. Chili—10 packages electrical material, $734. Dutch West Indies—2 cases electrical material, $22. Florence—1 package electrical material, $100. Genoa—3 packages electrical material, $100. Glasgow—4 packages electrical material, $159; 91 packages electrical machinery, $18,293; 2 rolls electrical cables, $1,016; 12,500 pieces electrical conduit, $6,000. Hamburg—1 package electrical machinery, $100; 36 packages electrical material, $2,499. Havre—10 packages electrical material, $295; 1 motor vehicle, $400. Haarlem—1 package electrical material, $136. Hayti—1 package electrical material, $40. London—216 packages electrical machinery, $7,907; 116 packages electrical material, $6,272; 13 cases auto vehicles, $2,480. Leicester—3 cases electrical machinery, $120. Liverpool—182 packages electrical machinery, $20,886; 33 packages electrical material, $1,532. Milan—2 cases electrical material, $30. Malta—1 case electrical material, $23. Manchester—9 cases electrical machinery, $2,576. Marseilles—2 packages electrical material, $134. Mexico—82 packages electrical material, $1,538. New Castle—1 case electrical machinery, $50. Peru—4 packages electrical material, $129. Rome—1 package electrical material, $100. Southampton—52 packages electrical material, $2,089; 85 packages electrical machinery, $1,865; 7 cases auto vehicles, $350. Stettin—4 packages electrical machinery, $435. Uruguay—1 package electrical material, $42. U. S. Colombia—2 packages electrical material, $39; 178 cases electrical machinery, $4,565. Venezuela—19 cases electrical material, $502.

ORDERS FOR ELECTRIC CRANES.—Pawling & Harnischfeger, Milwaukee, Wis., are operating with a double crew, and have a larger force of men employed than at any previous time in their history. They have an initial order for the new Allis-Chalmers Works at Milwaukee for one 75-ton, one 25-ton, three 40-ton electric traveling cranes. Other orders are for the Baldwin Locomotive Works, Philadelphia, five 10-ton electric traveling cranes, one 10-ton and two 20-ton; Lackawanna Iron & Steel Company, Buffalo, four 5-ton; Oil Well Supply Company, Oil City, Pa., one 40-ton; Pennsylvania Railroad Company, four 5-ton; Standard Steel Works, Burnham, Pa.; Lukens Iron & Steel Company, two 10-ton, 97 ft. 8-inch span; Columbus Iron Works Company, Columbus, Ga., one 20-ton; Crucible Steel Company, of America, Atha Works, one 15-ton; Pittsburg Reduction Company, one 50-ton; American Locomotive Company, one 10-ton; Fred M. Prescott Steam Pump Company, two 10-ton; Monongahela Manufacturing Company, one 10-ton; Northern Foundry & Machine Company, one 15-ton. They have also sold a large number of one and two-motor electric hoists during the past month, and the inquiries received indicate a large volume of business for the future.

CARS FOR SOUTH AFRICA.—The British engineering and contracting firm of Macartney, McElroy & Co., whose New York offices are located in the Havemeyer Building, 26 Cortlandt Street, has secured a contract from the Durban Corporation, calling for the shipment of eight cars for utilization on the electric traction system of that South African city. The cars, which will be of double-deck type and will have a seating capacity for 50 persons, are to be built at the Jackson & Sharp plant at Wilmington, Del., now controlled by the American Car & Foundry Company. The General Electric Company has been allotted the order for the requisite double-motor equipments, and the J. G. Brill Company, of Philadelphia, will furnish the trucks. The cars will be forwarded by direct steamer to Port Natal in the late fall. The Durban system's cars already in use are of British manufacture.

AMERICAN MANUFACTURING DATA.—Mr. Carroll D. Wright, in a recent article in the *World's Work*, says: The number of manufacturing establishments in 1890 was 355,415. At the present time the Census Office has received the schedules of 653,000, but probably not more than 500,000 of these are for establishments comparable with those counted in 1890. Taking this calculation as fairly correct, however, there has been a gain in the 10 years of nearly 150,000 establishments engaged in the manufacture of goods. The total value of products, including receipts from custom work and repairing, in 1890 was $9,372,783. Basing an estimate on the increase in the number of establishments and the tabulations of States already completed, a most conservative figure for the value of all products in 1900 is $15,000,000,000.

TRADE WITH SOUTH AFRICA.—The effects of war and plague are still evident in South Africa, and in several of the colonies industry and trade are almost paralyzed, according to Consul-General Stowe, who reports to the State Department from Cape Town, as follows: Trade is not inactive, however, and many arrangements in anticipation of an early termination of the war are being made. Orders have been placed for steel rails and rolling stock, which will be required on the cessation of hostilities; also for bridge and structural iron and galvanized sheet iron, immense quantities of which will be needed. The rebuilding of the telegraph lines will call for much material, and the various electric installations and sanitary and water works planned or under way are to be completed.

BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES FOR FRANCE.—The Societe Industrielle d'Electricite Procedes Westinghouse (The French Westinghouse Electric Company) have just ordered 12 Baldwin-Westinghouse electric locomotives which are intended for mining use in the French coal regions. The electrical parts of these locomotives will be manufactured at the Pittsburg works of the Westinghouse Electric & Manufacturing Company. The engines will weigh somewhat over 4½ tons each. They will be shipped to Marseilles.

MORE ELECTRICAL MACHINERY FOR SYDNEY TRAMWAYS.—The Allis-Chalmers Company will next month make a shipment from its Milwaukee plant of 10 carloads, consisting of a 1500-hp vertical cross-compound engine, etc., for the central generating station of the Sydney City & Suburban Tramways.

CARS FOR ARGENTINE REPUBLIC.—The St. Louis Car Company will soon commence shipment on a contract for 250 cars, recently secured from one of the principal electric traction systems in Buenos Aires, South America. It is also about to make shipments of some 40 cars for use on the Lisbon, Portugal, tramways.

ELECTRICAL SUPPLIES FOR CHINA.—The Manhattan Electric Supply Company, of 32 Cortlandt Street, New York City, is at present shipping some fair-sized quantities of its specialties to E. E. Porter, Shanghai, China.

Special Correspondence.

ENGLISH NOTES.

London Office, Electrical World and Engineer, Aug. 22, 1901.

EQUIPPING THE MERSEY TUNNEL.—The bill for the electrical equipment of the tunnel under the Mersey of the Mersey Railway Company has finally passed, and Liverpool will now have a third system of electric haulage. It already has a magnificent surface tramway system, a well conducted and efficient overhead electric railway, and it will now have a deep level tunnel railway operated by electricity, a large portion of which is underneath the Mersey between Liverpool and Birkenhead. At the next meeting of the company it is expected that an important pronouncement will be made as to the new scheme. The Mersey Railway, it is interesting to note, was opened on Jan. 20, 1886, by his Majesty the King (then the Prince of Wales).

UNDERGROUND IN LONDON.—The Great Northern & City Railway is making good progress, and so far as tunneling is concerned it is practically completed. This road is to connect the Great Northern Railway system at Finsbury Park with a station in the city at Finsbury Pavement, and the tunnels have been constructed large enough to accommodate the regular rolling stock of the Great Northern Railway. The contract for the electrical equipment is to be given out immediately, and though no contracts are yet decided, it is understood that the British Thomson-Houston Company is looked upon as the likely contractor. The new line will be about three and a half miles in length. There will be five stations and the two termini. The two tubes vary in depth from between 60 ft. to 90 ft., the railway in the vicinity of the Essex Road Station being the deepest part. To prevent or minimize vibration the lower half of the tunnels is built of concrete and brick, while the upper portion has a "roof" of iron.

"PRODUCER" GAS PLANT.—Electrical engineers are interested at present in the formation of a company called the Power Gas Corporation, which is a company formed to install throughout the country the new "Mond gas" plants for the production of gas for power purposes only. The bill giving statutory rights for the installation of these plants recently passed both Houses of Parliament, and it is understood that the company claims that it can produce gas for heat and power, which can be used for the production of electricity, cheaper than electricity can be generated at Niagara Falls. From such reports as are available "Mond gas" can do all that is claimed for it, and the new power is to be backed by a most influential syndicate. The chairman is to be Sir Henry Fowler, M. P., and the two vice-chairmen, Dr. Ludwig Mond, of Brunner, Mond & Company, and John Brock, of the United Alkali Company, while among the other members of the board will be one of the directors of Pease & Partners, and also one of the directors of the Castner-Kellner Alkali Company.

SCOTTISH POWER TRANSMISSION.—After an exhaustive inquiry, which lasted over five days, the Select Committee of the House of Lords has accepted the preamble of the Clyde Valley Electrical Power bill. Though the area of supply contained in the Clyde Valley bill comes to 700 square miles, it is all connected with the one county of Lanarkshire. The new company will start at a charge of 4 cents per unit and expects to go down as low as 2 cents. The circumstance that Messrs. Denny and some of the other largest industrial consumers in the Clyde Valley were numbered among its promoters may have weighed largely with the Lords as well as with the Commons in passing the scheme. These firms have in view not so much direct profit as the improvement of their works by the importation of a cheap supply of electric energy. The introduction of electric power forms a valuable step in this direction, and the more widely it is spread the greater will be the benefits it is capable of conferring on our industries. So far the area included in the Clyde Valley bill has been to some extent curtailed by the concessions granted on a previous occasion to Govan, Patrick, Paisley, Port-Glasgow and Hamilton, and now to Motherwell and Hamilton. But though these burghs have succeeded in depriving the company of the power to enter their boundaries compulsorily, they can still treat with it for adequate supplies of energy.

THE NEW WESTINGHOUSE WORKS.—The ceremony of the laying of the cornerstone of the new works of the British Westinghouse Electric & Manufacturing Company at Trafford Park, Manchester, by the Lord Mayor of London, supported by the Lord Mayor of Manchester and Sheriffs of London, has gone off with great eclat. Special trains were provided from London and special accommodations at the hotels, and after the ceremony an elaborate but informal luncheon was served. The ceremony itself was performed on a covered platform decorated with flowers and flags, and the stone was placed in the full view of all interested. Among those present were: C. W. Benson (deputy chairman), Lemuel Bannister, P. F. Kobbe, J. H. Lukach, J. Annan Bryce, J. F. Mason, Arthur E. Scanes (secretary), W. H. Wells (business manager), and J. E. Stewart (building manager). Other guests who had seats on the platform were: Sir J. H. Rider (electrical engineer to the London County Council), Mr. Turnbull (electrical engineer to the Corporation of Tynemouth), and Mr. Chattock (electrical engineer to the Corporation of Bradford), while among the prominent firms represented at the function were the following: J. G. Brill Company, Callender's Cable & Construction Company, Lacey, Clirehugh & Sillar, Maguire & Baucus, Metropolitan Railway Carriage & Wagon Company, Niles Tool Works, James Simpson & Company, Sloan Electrical Company, South Durham Steel & Iron Company, and many others. The list of guests also included the chairman of the electrical committees of the following towns: Accrington, Ashton-under-Lyne, Bacup, Bolton, Burnley, Buxton, Darwen, Farnworth, Halifax, Haslingden, Huddersfield, Manchester, Macclesfield, Middleton, Oldham, Preston, Radcliffe, Royton, Salford, Stalybridge, Stockport, Saint Helen's, Bury and Rochdale. R. H. Porter, formerly chief of the United States Census Department, seconded the vote of thanks, and aroused the enthusiasm of the audience that the warp of British finance, of British experience and British conservatism, interwoven with the ingenuity, energy and enterprise of American weft, would offer a pretty hard front for the rest of the world to combat. The works have already been described in these columns.

General News.

THE TELEPHONE.

RUSSELLVILLE, ALA.—The telephone line from Tuscumbia to this place has been completed. An exchange will be established here in a few weeks.

CAMDEN, ARK.—The Eastern Telephone Company, with a capital stock of $1,000, started business on July 16 last with 32 miles of toll line, and connects with other lines in Camden. Extensions will be made next spring to Warren, Ark.

WILMINGTON, DEL.—The Delmaravia Telephone Company has nearly completed the work of extending its lines to Elkton.

KISSIMEE, FLA.—C. A. Carson has obtained a charter and will establish a local telephone exchange.

ATLANTA, GA.—The Standard Telephone Company's plant in this city is being overhauled. New apparatus will be installed.

COVINGTON, GA.—The Covington Telephone Company has organized, with C. C. Brooks president, and has commenced work on the construction of its system.

ROME, GA.—The Southern Bell Telephone & Telegraph Company has begun work on its new system in this city, and will erect a new exchange, taking out the old telephones and replacing them with the metallic, long-distance instruments.

AUGUSTA, GA.—As a result of the arbitration as to the value of the Augusta Telephone Company, operating the Strowger system, it was determined that the property be returned for taxation at $22,000 instead of at about $18,000, as the owners had returned it.

AVON, ILL.—A new telephone exchange is being installed at Avon.

CLINTON, ILL.—B. F. Wasson was in Beason arranging to put in a local telephone exchange.

JERSEYVILLE, ILL.—A telephone line has been constructed from Carrollton to Hardin via Kampsville.

FAIRBURY, ILL.—The Fairbury Telephone Company has been granted a franchise by the City Council.

MACOMB, ILL.—The Kurtz Telephone Company was granted a franchise to enter the city and operate an exchange.

CENTRALIA, ILL.—E. A. Knapp, representing the Central Union Company has asked for a telephone franchise in Salem.

CLINTON, ILL.—The Farm & City Telephone Company will rebuild the local lines here as soon as the Decatur line is completed.

STERLING, ILL.—S. S. Creider has been awarded the contract for rebuilding of the telephone line along the canal south from Rock Falls.

CARLISLE, ILL.—A telephone exchange will be established in Sandoval by Charles E. Hull, of Salem. Fifty subscribers have been secured.

DUNDEE, ILL.—A new switchboard has been placed at the central telephone office, which will accommodate about 300 subscribers. There are now about 100 subscribers on the local exchange, and the number is constantly increasing.

HUMBOLDT, ILL.—The Humboldt Telephone Company, capital stock $2,500, has been incorporated. Incorporators: James McDougle, S. C. Ashbrook and E. M. Mulliken. The line will be connected with the exchange at Arcola.

CHAMPAIGN, ILL.—The Palmer Darnell Electric Company, of Atlanta, has purchased the telephone lines and exchange belonging to Dr. J. H. Banks, and will consolidate with the extensive telephone system recently incorporated.

CHICAGO, ILL.—The Eureka Telephone & Construction Company has been incorporated in Chicago, with a capital stock of $50,000 to manufacture telephone and electrical appliances. The incorporators are Henry R. Platt, John Rollings, Sydney Stein.

CARLISLE, ILL.—The resident manager of the Clinton County Telephone Company, J. W. Johnson, has announced that the line will be extended to Keyesport, fourteen miles northeast of this city. Extensions will also be built to Boulder, Hoffman, Posey, Bartelso, St. Rose and Jamestown, which places are at present without telephone facilities.

PEKIN, ILL.—The Citizen's Telephone Company has awarded the contract for the construction of its telephone system in Pekin to Jones & Winters, of Chicago, for $26,672. This does not include dynamos, switchboards, power plant and instruments; these contracts are to be let later. It is estimated that by the time the plant is in working order from $35,000 to $40,000 will have been expended.

DIXON, ILL.—At a meeting of the Dixon merchants it was agreed to use the Central Union telephone service only until Oct. 1, at the old rates of 50 cents a month for residences and $1.50 for business houses. The proposition that the Central Union Company submitted to the merchants that after Oct. 1, the rate would be $1.50 for residences and $2 for business houses, is held for further consideration.

GOSHEN, IND.—The Wakarusa Telephone Company is extending its line in the country to the south.

ELKHART, IND.—E. C. Bickel, of this city, has just purchased the Home Telephone system of South Haven, Mich., for a consideration of $10,000.

RICHMOND, IND.—The American Bell Telephone Company has appealed to the State Board of Tax Commissioners from the assessment placed on its property by the Wayne County Board of Review.

ELKHART, IND.—The Central Union Telephone Company announces that it wil put in an exchange at Wakarusa to compete with an independent plant there. The independent concerns are strong in this section, and it will only be a few weeks when Elkhart and Goshen people may talk to Cleveland and Indianapolis over independent wires.

LOGANSPORT, IND.—Fort Wayne capitalists, headed by Theodore Thorward, has submitted to the City Council a petition for a fifty-year franchise to build and operate an independent telephone plant in this city. The prospects for a grant are good. Councilmen favor but one exchange, and the Central Union's franchise expires in January. A petition for a renewal will likely be denied.

INDIANAPOLIS, IND.—The Indiana Tax Commissioners have just finished their forty-five day's session. Secretary Martin gave out a comparative statement showing the total amount of corporate telephone assessments this year to be $4,436,663, against $2,929,190 for last year, an increase of $1,509,473. The increase during the year in telegraph property is shown to be only $1,120. The rapid increase of telephone property over that of telegraph property is a subject of considerable comment.

FRANKLIN, IND.—Great excitement prevails here over the controversy between the Central Union and independent telephone companies. Originally the Central Union was given a franchise to operate a telephone exchange in this city, but after establishing a plant it was removed elsewhere, and this territory was abandoned, as claimed by its opponents. An independent company was recently given a franchise, thereupon the Central Union attempted to establish another exchange here, but the Council revoked its franchise and ordered the city marshal to arrest any person attempting to erect poles. Undaunted, the Central Union put linemen to work, but all were arrested on the charge of trespass and obstructing the streets. The Central Union then obtained from Judge Baker, of the United States Court, a temporary restraining order against the city officers enjoining them from removing poles and wires and interfering with the company's property until Oct. 1, when the case will be finally determined. The next move expected is for the city to obtain an injunction from the County Court to prevent the Central Union from constructing its plant until Oct. 1.

GRUNDY CENTER, IA.—The Grundy County Telephone Company has been organized here.

AFTON, IA.—Articles of corporation have been filed for the Afton Mutual Telephone Company. Incorporators: J. H. Van Scoy, H. P. Armitage, C. A. Pierson, M. W. Keating, J. W. Coen and A. B. McDaniels and L. M. Walker.

HARPER, KAN., is to have a telephone exchange.

SALINA, KAN.—The Salina Telephone Company has increased its capital stock from $25,000 to $50,000.

STANDISH, MAINE.—The telephone line from this village to Watchie Pond will soon be in operation.

SKOWHEGAN, MAINE.—The Somerset Traction Company is putting in a private telephone line between Madison and this place.

SOUTH PARIS, MAINE.—The Sumner & Paris Telephone & Telegraph Company has been organized, with A. E. Dean president.

GRAY, MAINE.—The New England Telephone & Telegraph Company has a large force of men at work on a telephone line from Gray Corner through West Gray and to North Windham and other points west.

BUCKFIELD, MAINE.—At a hearing before the selectmen of Buckfield, the New England Telephone & Telegraph Company was granted pole rights in the town of Buckfield. It is understood that the company will at once begin work on the establishment of a line between Buckfield and Turner. At a similar hearing the Oxford County Telephone & Telegraph Company was also granted pole rights in that town. This telephone line is already very nearly completed.

LANSING, MICH.—The Union Telephone Company, of Alma, has increased its capital stock from $150,000 to $200,000.

DETROIT, MICH.—At the Wyandotte Council meeting the Aldermen will consider the granting of an independent telephone franchise.

BAY CITY, MICH.—The Michigan Telephone Company is preparing to extend its lines in the territory north of this city, and will eventually cover every important point between here and Alpena and Mackinaw City.

HART, MICH.—The Oceana Telephone Company has sold to the Pere Marquette Telephone Company, of Ludington, that portion of its telephone plant located in Mason County, on the north of the county line between Mason and Oceana counties. The Pere Marquette Telephone Company will collect all moneys due the Oceana Telephone Company in this district and pay all debts owing by said Oceana Telephone Company. Geo. S. Root is secretary of the Oceana Company.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will erect a new two-story brick and stone building to cost $25,000.

ST. PAUL, MINN.—The Winona Telephone Company has secured the passage by the Rochester City Council of an ordinance permitting it to install pay telephone stations in that city.

ST. PAUL, MINN.—The assembly has passed the resolution directing City Engineer Clausen to remove all telephone, telegraph, electric light and power wires on streets where the orders of the Council for their removal had not been obeyed.

LAUREL, MISS.—The Mississippi Telephone Company, capital $3,000, has been incorporated by W. Welborn, E. D. Pierce, J. W. Watt and N. P. Welborn.

SUMNER, MO., is to have a telephone exchange.

KANSAS CITY, MO.—More than 1000 farmers in Mercer County have telephones in their houses.

BOZEMAN, MONT.—The Bozeman & Pass Creek Telephone Company has been incorporated, with a capital stock of $5,000.

REIDSVILLE, N. C.—The Southern Bell Telephone & Telegraph Company has made application for franchise for a telephone exchange at Reidsville.

FINGAL, N. D.—The telephone line from Fingal to Valley City will soon be in operation.

BISMARCK, N. D.—The State's attorney, Allen, has begun work on the installation of a telephone system in Bismarck.

JAMESTOWN, N. D.—C. L. King, in charge of the exchange of the North Dakota Telephone & Electrical Company at Harvey, has refused to turn it over to C. E. Leslie, who purchased the line from Receiver Murphy at a sale held July 25. Judge Glaspell has issued an order confirming the sale and ordering the line turned over to Leslie and proceedings to secure the possession of the central outfit at Harvey will be instituted.

BRADY, NEB.—The Maxwell & Brady Telephone Company has been incorporated, with a capital stock of $200,000.

WISNER, NEB.—The Holt County Telephone Company has been organized at O'Neill, with a capital stock of $10,000. It will connect with the Nebraska Company at Ewing, thence to Spencer and Butte on the north, and south to Chambers.

FORT EDWARD, N. Y.—The Hudson River Telephone Company will reconstruct the telephone system in this village.

SCHENECTADY, N. Y.—The Schenectady Home Telephone Company has been incorporated, with a capital stock of $250,000, to maintain lines of telephone in Schenectady and Niskayuna, Duanesburg, Braman's Corners, Rotterdam Junction and intermediate towns in Schenectady County. The directors are Samuel B. Rawson, T. M. Brush, I. H. Griswold, J. A. Dake, D. H. Sudro, A. E. Lord and E. M. Brush, of Elyria, Ohio, and Howard Hendrickson, of Albany.

TROY, N. Y.—The Cohoes-Waterford Home Telephone Company, whose principal office is to be in Cohoes, has been incorporated with the Secretary of State. It proposes to carry on operations in the counties of Albany and Saratoga, especially between Cohoes and Waterford. The capital stock is $200,000. The directors are S. B. Rawson, F. H. Sudro, I. H. Griswold and J. A. Dake, of Elyria; Howard and Hendrickson, of Albany; Jas. H. Shine and John Clute, of Cohoes, and Thomas Breslin, of Waterford.

CLYDE, OHIO.—The Clyde Telephone Company has increased its capital stock from $10,000 to $40,000.

TROY, OHIO.—The Home Telephone Company is considering the matter of extending its line throughout this vicinity.

MASSILLON, OHIO.—The Massillon Telephone Company has opened its branch exchange at Dalton with 40 subscribers.

CANTON, OHIO.—The Stark County Telephone Company, Canton, has increased its capital stock from $100,000 to $500,000.

DELAWARE, OHIO.—The Citizens' Telephone Company has increased its capital stock from $40,000 to $60,000. The company now has 600 subscribers.

HUBBARD, OHIO.—The Hubbard Council has granted a franchise to the Youngstown Telephone Company for the purpose of operating a telephone system here.

GREENBUSH, OHIO.—The local telephone exchange has been sold to the Gratis Telephone Association, and that company is making preparations for a number of extensions.

FOSTORIA, OHIO.—The Central Union Telephone Company is preparing to rebuild its local exchange at an expense of $20,000. A farmers' line is being built to the village of Arcadia.

CEDARVILLE, OHIO.—The Council has granted a franchise to the Home Telephone Company, an independent company that will work in conjunction with other independent companies.

COLUMBUS, OHIO.—The New Washington Telephone Company and the Huron County Telephone Company, of Bellevue, have consolidated under the name of the Huron County Telephone Company.

KENT, OHIO.—The Central Union Telephone Company has refused to accept the franchise granted by the City Council, claiming that the rate clause is unsatisfactory. The Probate Court will probably be appealed to.

GENEVA, OHIO.—The new system of the Madison Telephone Company at this point will be placed in operation within a few days. The lines are being rapidly equipped with new instruments and the switchboard is neadly ready.

NEW LEXINGTON, OHIO.—Application was made to the Council for a franchise for a new telephone line, the object being to secure direct telephone connection between this place and other points in this and adjoining counties.

TOLEDO, OHIO.—Construction work on the new system of the Toledo Home Telephone Company has been started by a large force of men. Over one hundred carloads of material have been received and the work is progressing on all parts of the system. Manager Graves expects to have a large portion of the system in operation by Jan. 1.

CINCINNATI, OHIO.—The Board of Trade and other business men's associations are agitating a movement for the establishing of an independent telephone exchange in Cincinnati. The City & Suburban Telegraph Association, a Bell licensee, is said to have only about 10,000 subscribers, while Cleveland alone has over 22,000, and Columbus, which is only about one-half as large as Cincinnati, has nearly as many telephones. It is claimed that the lack of independent telephone facilities is a serious drawback to the development of the business at this point. A company, known as the Fitzsimmons Telephone Company, claims to hold a grant covering a system throughout the city, and it has in operation about 1,200 telephones, the majority of them being in private systems not connected with a main exchange, and this grant will be utilized by a new company which is said to be in process of organization.

PORTLAND, ORE.—The Board of Public Works of Portland has granted a ten-year franchise to the Pacific States Telephone Company.

GUTHRIE, O. T.—The Red River Valley Telephone Company has been issued a charter, with a capital stock of $50,000, to do a general telephone business in Oklahoma. The place of business is to be Lawton, Comanche County. J. A. Overstreet, of Kingfisher, is president.

MANSFIELD, PA.—The Citizens' Mutual Telephone & Telegraph Company, capital stock $1,000, has been incorporated.

UNIONTOWN, PA.—The Farmers' telephone line from Greensboro to Davidson and branches have been sold at this place by the Sheriff.

PHILADELPHIA, PA.—The Perkiomen Telephone Company has received the right to erect poles and to string wires through Pennsburg and East Greenville.

PENNSBURG, PA.—The Home Telephone Company of this place is planning to extend its lines to Red Hill, East Greenville, Greenlane, Sumneytown and other villages.

COATESVILLE, PA.—The United Telephone & Telegraph Company has erected poles from Coatesville to within one-half mile of the borough line of Parkersburg, and expected to have the wires strung and connection established by Sept. 1.

LEBANON, PA.—The United Telephone & Telegraph Company is constructing a direct trunk line between Lebanon and Lancaster.

ALLENTOWN, PA.—The Lehigh Valley Traction Company has announced the purchase of the line from Quakertown to Perkasie from the Quakertown & Philadelphia Traction Company. The line is needed as a connecting track between this city and Philadelphia.

ALTOONA, PA.—The Cresson Telephone Company has bought the stock and franchises of the Northern Cambria Telephone Company, operating lines at Nicetown, Spangler, Barnesboro, Hastings and Patton. The Cresson Company now connects with Altoona and Johnstown.

UNION, S. C.—The Southern Bell Telephone & Telegraph Company will establish an exchange at Union.

PITTSTON, PA.—A movement is on foot for consolidation of the Central Pennsylvania and People's Telephone lines. The patrons, who have been enjoying a cut rate telephone service, will shortly be given the reverse. Already the Pennsylvania Company, which will absorb the People's Company, has increased the rental for business places. The People's Company is but a young concern, with lines extending from Hazleton to Carbondale.

BRIDGEWATER, S. D.—The Bridgewater Union Telephone Company at Bridgewater, capital stock $1,500, has been incorporated. Incorporators: P. H. Hyntom, J. J. Heinrich, Ed. Guenther, Alex. N. Meyers and Charles L. Marsh.

PIERRE, S. D.—A project is under way for the construction of a telephone line from this city to the Black Hills. The company for the purpose is to be incorporated, and work is to be begun at once. The line will connect with the Black Hills system and give that section direct communication with the eastern part of the State.

MEMPHIS, TENN.—The Cumberland Telephone Company and the Memphis Telephone Company have reached an agreement by which there will probably be no more litigation between them over the erection of the new telephone system in this city.

MEMPHIS, TENN.—The Memphis Telephone Company, the representative of the independent system of this city, will build its own exchange. The contract has just been let. The building will be three stories high, will be built of brick and stone, will cost about $30,000, and, when completed, will be one of the handsomest structures of the kind in the entire South.

SAN ANGELO, TEX.—The San Angelo Telephone Company has been incorporated, with a capital stock of $80,000.

ANDERSON, TEX.—The Anderson Telephone Company has completed the line to Retreat and White Hall, and will soon build to Courtney.

ORANGE, TEX.—The Orange Telephone Company has been incorporated, with a capital stock of $40,000. The incorporators are Melville D. Shaw, Walter D. Bettes, C. N. Haskell, J. S. Brailey, and others.

WAXAHACHIE, TEX.—The Commissioners Court, in session here, granted a franchise to Malloy & Company, of Ferris, and Truitt & Thompson, of Bristol, for the erection of a telephone line between the towns of Ferris and Bristol, also taking in the town of India.

PARIS, TEX.—The directors of the Southern Telephone Company met in Paris and elected Jasper N. Yeager, of Lake Creek, Delta County, manager, in place of W. L. Miller, resigned. It was decided to put in a central office and establish a local exchange in Paris.

RICHMOND, VA.—F. D. Drewry and others have organized the Virginia Telephone Company (copartnership) for the construction of a telephone system connecting various mines with the long-distance lines.

GRAFTON, W. VA.—The Consolidated Telephone Company has been incorporated. Authorized capital $300,000; incorporators, William Morgan, B. T. Bailey, of Grafton; C. E. Pride, of Clarksburg, and others.

WILLIAMSBURG, VA.—The stockholders of the Chesapeake Telephone & Telegraph Company re-elected the present officers as follows: President, E. E. Slaight; Vice-President, George L. Smith; Treasurer, E. T. Hudgins; Secretary, J. E. Crockett. The following board of directors was elected: Messrs. J. W. Clements, E. T. Lee, S. R. Curtis, H. S. Bird, G. L. Smith, G. W. Warburton and J. E. Crockett.

SPOKANE, WASH.—The Rocky Mountain Bell long-distance telephone line has been extended to Hailey.

LA CROSSE, WIS.—A plan is being matured whereby the La Crosse Telephone Company will extend its lines from this city to La Crescent, Minn., and Eagle Bluff.

BABCOCK, WIS.—The Independent Telephone Company, of Grand Rapids, recently completed a line from Pittsville to Babcock, by way of Dexterville. During the fall a central office will be established here, providing the company can secure enough subscribers.

TWO RIVERS, WIS.—The Two Rivers Telephone Company has let a contract for the installation of an entire new system, to take the place of the one now in use, which is no longer adequate to meet the demands. The system will have long-distance connections.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company has been incorporated. This move is the preliminary step to the final combination of all independent telephone interests in the State. The main office of the company will be in this city, but the active field of operations will be the Fox River Valley, as the company has options on all the property and franchises of the Fox River Valley, Little Wolf River and Wolf River Telephone Companies, with about 30 exchanges. The systems under the control of the new company will be greatly improved and extended. W. W. Townsend and F. H. Lord, of Chicago, and A. L. Hutchinson, of Weyawega, will have active charge of the affairs.

ELECTRIC LIGHT AND POWER.

SAN BERNARDINO, CALIF.—The Edison Electric Company has purchased the California Power Company, and the plant of the latter concern will be pushed to completion.

SAN FRANCISCO, CALIF.—The Central Supply Plant has been incorporated, with San Francisco as the principal place of business. Directors: W. H. Payson, H. F. Peart, E. A. Clauson, N. Fancher and C. S. Chandler. Capital stock, $75,000; subscribed, $500.

LOS ANGELES, CALIF.—The Mentone Power Company, with principal place of business in Los Angeles, has incorporated, with a capital stock of $500,000, of which amount $5,000 has been subscribed. The directors are W. G. Kerckhoff, E. A. Beck, Otto Weiss, H. W. O'Melveny and M. G. Eshman, all of Los Angeles.

WOODLAND, CALIF.—The city of Woodland is soon to pump all of its water by electric power, steps to that end having already been taken. Arrangements have been made with the Bay Counties Power Company, through its local agent, to furnish the necessary power and a contract will soon be let to a San Francisco firm for the construction and installation of an electrical pump at a cost of $2,750. The City Trustees figure on saving $275 per month as a difference between the cost of pumping the water by steam now in use and electricity.

PEORIA, ILL.—The Central Electric Company of this city has increased its capital from $5,000 to $25,000.

WARREN, IND.—This city has just completed and installed a new electric light plant at a cost of upwards of $30,000.

MUNCIE, IND.—Officers of the local Heat, Light & Power Company have demanded a new franchise and assert that unless a new and more liberal franchise is granted whereby an increase in rates may be exacted, the company will be unable to furnish current for heat, light and power. The company has already cut off the factories, and without an increase in rates improvements necessary cannot be made. The people are opposed to yielding to the company, after fighting the rate question through the courts.

MUSKEGON, MICH.—Plans have been drawn for a new plant for the Muskegon Traction & Lighting Company. They provide for the expenditure of $100,000 in the erection of a modern fireproof structure to be completed by Dec. 1. Power will be furnished for both the street railway and the city lighting system.

ST. LOUIS, MO.—The Board of Public Improvements Aug. 27 took the first step towards municipal management of the lighting of public buildings. An ordinance was approved and sent to the House of Delegates which authorized the board to wire all buildings owned by the city. The city owns the wires and attachments in the City Hall, but not in other buildings. The cost of wiring is not a small item financially. Members of the board believe that it would be to the city's advantage to own the wiring and attachments, for independence, if for no other reason. It is said that the plan is to purchase the wires now in use.

GREENSBORO, N. C.—The Greensboro Gas & Electric Light Company is making extensive improvements to its plant, including a new building and new machinery.

LAURENBURG, N. C.—A meeting of citizens has decided to employ a civil engineer to make surveys to ascertain the probable cost of an electric light and water system.

LEXINGTON, N. C.—It is said that the present owners of the town electric light plant have decided to suspend operations indefinitely, thus creating an opening for a new company.

ORANGE, N. J.—The National Electric Heat, Light & Power Company is trying to oust President John Seymour of the Common Council from office because he voted against the company on the question of the contract for street lighting. The United Electric Company is the competitor of the National Electric Company, which submitted a bid for municipal lighting in Orange in competition with the United Electric Company, which holds the contract. Had the bid of the National Company been accepted, it would have resulted in a saving of $22,500 to the city in five years. A motion to grant the contract to the National Company was lost by a tie, President Seymour voting in the negative. The National Company now claims the contract was awarded it by a vote of 8 to 7 on the ground that Mr. Seymour is not a legal member of the Council and had no right to vote.

BUFFALO, N. Y.—The Western New York Water Power Company, of Buffalo, has been incorporated to manufacture electricity; capital, $50,000. Directors: Edward S. A. McLeod, W. E. Frampton and F. B. Hartzell, of Buffalo.

BUFFALO, N. Y.—What is said to be the first planing mill run by electricity in this country has begun operations on Goode Island, near Tonawanda. Two motors of 125 horse-power each were installed by the owner, Frank I. Allinger, and these suffice to run all the machinery in the mill. The owner thinks he will make a great saving by substituting electricity for steam.

CINCINNATI, OHIO.—The contract for street lighting in this city for ten years after June 1, 1902, has been signed by President Hickenlooper, of the Cincinnati Gas & Electric Company, and by the city representative. The company will install an underground conduit system. The contract involves about $4,000,000.

FREMONT, OHIO.—An independent company has been organized by local business men, to build a steam heating, gas and electric lighting plant for the purpose of competing with the company which has recently bought up the local plant and raised prices for illumination. A franchise ordinance has passed its first reading.

HUBBARD, OHIO.—Lamprecht Brothers, Cleveland brokers, who were awarded the issue of $8,000 in bonds for the purpose of building a municipal lighting plant, have declined to take the bonds, claiming the issue was illegal.

An attempt is being made to place the bonds with the next highest bidder. Bids have been received for the equipment of the plant.

AKRON, OHIO.—It is said that the scheme of the Hartford, Conn., syndicate to build a large power plant at the falls in the Cuyahoga River, near Cuyahoga Falls, has been blocked by Henry A. Everett, who is stated to have secured control of the water front on both sides of the river for a distance of half a mile from the large falls. The syndicate has secured options on a long strip of water front, but the Cleveland gentleman controls the situation at the vital point. It seems probable that he has other plans for utilizing the power developed at the falls.

WINSBORO, TEX.—The Chickasha Electric Company, of Winsboro, Wood County, capital stock $60,000, has been incorporated by L. S. Schluter, W. T. Muteman and E. M. Decker.

MILWAUKEE, WIS.—Messrs. Keelyn & Smith are installing an electric lighting plant in the coal docks of the C. Reis Coal Company, at Ashland, Wis.

WAUKESHA, WIS.—The Waukesha Sheet Steel Company will install an electric power plant, consisting of a 75-kw generator, electric crane, electric pump, two 20-hp, one 10-hp and one 5-hp motors.

MILWAUKEE, WIS.—Geo. F. Rohn has secured the contract for the electrical equipment of Gimbel Brothers' new department store in this city. The equipment comprises wiring and iron conduit for one 75-hp and six 40-hp motors, 200 enclosed arc lamps and 500 incandescent lamps.

THORP, WIS.—The brick power-house of the Thorp electric light plant has been completed. A force of workmen is now engaged in setting poles and wiring the same for the thirteen 1500-cp arc lights, while business houses and private residences are being wired preparatory to the introduction of lights as soon as the engine, boiler and dynamo shall have been placed in position and connected ready for operation. All the machinery is new and the plant is expected to be ready for operation by October 1. The plant when completed will cost $10,000 and will be owned and operated by the village.

LA CROSSE, WIS.—In view of the fact that the Council has been asked for a twenty-five-year extension of the lighting franchise at rates merchants deem extortionate, all stores between Fourth, Fifth and Main and Jay Streets will be lighted by a lighting plant which will be erected and operated privately by the business men of the block. The business men say they could secure light much cheaper through the private plant. Included in the block are the largest consumers of light in the city, and owners say that they will not now withdraw, even if the company should withdraw its ordinance and make a suitable reduction in prices.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will spend $1,000,000 in improving the street railway systems of Birmingham and vincinity. New electric cars, costing $7,500 each, have been purchased, and will be put on the suburban lines between Birmingham and Ensley and Birmingham and Bessemer.

GADSDEN, ALA.—W. H. Weller, J. T. Weller and C. S. Ward have purchased from Capt. J. H. Elliott the Gadsden & Attalla Union Railway Company, consisting of the electric car line from Gadsden to Attalla, and the power-house and improvements. The electric car line will be consolidated with the Gadsden Light, Iron & Coal Company.

SANTA CLARA, CALIF.—A franchise has been applied for by George T. Dunlap, to construct an electric line in this county.

COLORADO SPRINGS, COLO.—W. A. Otis & Company, C. M. MacNeill, E. P. Shove, Henry Hine, A. Sutton, C. E. Noble, and Hall, Babbitt & Company, well-known Colorado Springs capitalists, have organized a company to build an electric railway to the top of Pike's Peak. The road will cost $500,000 or more. It will start from Colorado Springs or from some station on the Cripple Creek Short Line. The height will be 14,143 feet. Work will be begun immediately.

NEW HAVEN, CONN.—An Attleboro, Mass., dispatch says that some of the directors of the Massachusetts Electric Company's are back of a project to parallel the New Haven Railroad with an electric road between Boston and Providence.

JOLIET, ILL.—The Joliet & Chicago Electric Railway Comany, owned by the American Railways Company, will probably be ready to open the new line from Lamont to Chicago by the first week in September. The road is practically completed.

CHICAGO, ILL.—The Valparaiso, Michigan City & Chicago Electric Railway Company has been incorporated, with a capital stock amounting to $25,000, all of which is subscribed and paid in. The road proposed extends from Valparaiso to Chicago, passing through the following towns en route: Furnessville, Chesterton, Porter, Wheeler, Hobart, Tolleston, Clarke, Whiting, Crown Point, Hebron, Hessville and Highlands.

LA PORTE, IND.—The Lake Michigan & Central Indiana Railroad and Navigation Company has been organized by a syndicate of Chicago and Knox capitalists to build an electric line from Michigan City to Indianapolis, via La Porte.

LEAVENWORTH, KAN.—The Interstate & Leavenworth Railway Company of Kansas City, with a capital of $500,000, has been formed. The company is to operate street railways in Kansas City and Jackson County, Mo.; in Kansas City and Wyandotte County, and in Leavenworth and Leavenworth County Kan.

NEW ORLEANS, LA.—A deal is on foot which may result in the consolidation of the four street railway companies at New Orleans. H. H. Pearson, representing Edward C. Jones & Company, of New York, has been in New Orleans, for some time with the above end in view. The combined capital of the four companies is $9,903,300 and the aggregate bonded indebtedness is placed at $8,600,000. The four companies are: The New Orleans City Railway Company; capital $7,500,000; the Orleans Railway Company, capital $250,000; the New Orleans & Carrolton Railway Company, capital $1,200,000, and the St. Charles Street Railway Company, capital $953,000. Edward C. Jones & Company have recently purchased the electric light company at New Orleans, and are said to have about $5,000,000 invested in that city.

MYERSVILLE, MD.—After selling $35,000 of the bonds and a controlling amount of stock to Hagerstown people, a majority of the old directors of the Myersville and Catoctin Electric Railway have leased the road for ten years to the Frederick & Middletown Electric Railway Company, which still has a lease on it for over two years.

FITCHBURG, MASS.—The new electric railway between this city and Lunenburg has been opened.

WORCESTER, MASS.—The directors of the Uxbridge & Blackstone Street Railway Company have voted an assessment of 40 per cent on the capital stock of the company, the money to be used in constructing the road.

BOSTON, MASS.—Stone & Webster, of this city, have purchased the principal light plant, and have obtained a favorable street-railway franchise in the city of El Paso, Tex. Plans for the construction of the railway are under way.

BOSTON, MASS.—An order has been issued by the Railroad Commissioners authorizing the Middleboro, Wareham & Buzzard's Bay Street Railway Company to operate a line from Middleboro to the village of Rock, a distance of about five miles.

LANSING, MICH.—The incorporators of the new Western Michigan Electric Railway Company are: C. I. Hadley, of New York; C. W. Haight, New Haven; F. A. Hanshaw, S. F. Marchout and S. M. Howard, of Chicago.

LANSING, MICH.—Articles of incorporation of the West Michigan Traction Company, organized with $1,000,000 capital have been filed with the Secretary of State. The company proposes to build an electric line from the vicinity of Benton Harbor to Dowagiac, Cassopolis, Decatur, Pawpaw and Kalamazoo, a distance of 90 miles.

GRAND RAPIDS, MICH.—The Grand Rapids, Belding & Ionia is the name of a new electric interurban line which will, in the near future, connect Grand Rapids with Ionia, Ada, Lowell, Saranac and Belding. The organization has been effected. The company has a capital stock of $100,000, the incorporators being Wallace Franklin, Detroit; Thomas F. Carroll, and Joseph Kerwin. Thomas F. Carroll is the president of the new company; Treasurer, Wallace Franklin, and Secretary, Joseph Kerwin.

WILMINGTON, N. C.—The Wilmington Seacoast Railroad, from Wilmington to Wrightsville Beach, a distance of ten or twelve miles, has been sold, and it is understood that the object of purchasers is to convert it into a modern trolley system.

PORTSMOUTH, N. H.—The directors of the Portsmouth & Exeter Street Railway have petitioned for additional locations in Greenland.

CONCORD, N. H.—The Concord Street Railway was organized in 1878 and operates an overhead line of thirteen and a half miles, with five tow cars and three others. Extensions are now being built. The apparatus is General Electric and Westinghouse. President, A. L. Tuttle; superintendent, H. A. Albin.

GLOVERSVILLE, N. Y.—It is proposed to build an electric road through Minerva and Newcomb to Long Lake in Hamilton County.

COOPERSTOWN, N. Y.—The Oneonta, Cooperstown & Richfield Springs Railway Company has filed a certificate of increase of capital stock from $750,000 to $1,000,000.

FORT PLAIN, N. Y.—The Board of Trustees of this village have granted a franchise to the Mohawk River Traction Company to construct an electric railroad through several streets.

UTICA, N. Y.—The Cleveland syndicate, which has purchased the electric roads in this city and vicinity, has signed a contract to take 2500 horse-power from the electric plant at Trenton Falls.

CLINTON, N. Y.—An application has been made to the trustees of the village of Clinton, County of Oneida, by the Utica Suburban Railway Company for permission to construct and operate a street surface railway.

FREEPORT, L. I., N. Y.—The Mineola, Hempstead & Freeport Traction Company, which has received a franchise to build a trolley road here, has filed its required bond of $5,000. The Fidelity & Deposit Company of Maryland is surety for the bond.

ALBANY, N. Y.—The St. Lawrence & Adirondack Railway Company has declared a semi-annual dividend of 2½ per cent, payable September 1. This is the first dividend declared by the company. The directors elected A. L. Meyers vice-president of the company.

TROY, N. Y.—The State Board of Railroad Commissioners has granted the application of the Troy, Rensselaer & Pittsfield Electric Railway to construct an electric road from Troy to the Massachusetts State line and from Troy Through Bath into Rensselaer.

DEFIANCE, OHIO.—The Northern Ohio Electric Railway Company has filed a certificate of extension of route or line.

TIFFIN, OHIO.—The Tiffin & Southern Railway Company has been organized, with Michael Riley, of Pittsburg, president, and B. F. Brough, of Toledo, secretary and treasurer.

BOWLING GREEN, OHIO.—Riggs & Sherman have been appointed engineers and superintendents of construction for the Lake Erie, Bowling Green & Napoleon electric line.

MARION, OHIO.—Toledo men propose to build an electric line starting from Marion, Ohio, and passing through Edison and one or two other small places to Mount Gilead. Then it is proposed to extend the line from Marion westward.

SPRINGFIELD, OHIO.—The Pennsylvania Railroad, it is said, is arranging to operate the line between Springfield and Xenia by electricity. It is stated also that the Pennsylvania has secured rights along the Miami Canal, which runs from Toledo to Cincinnati, and will build an electric line along the towpath.

TOLEDO, OHIO.—The Everett-Moore people have secured control of the Western Ohio Traction Company, which is now constructing a line between Lima and Piqua. The syndicate, it is learned, have already begun negotiations for the purchase of the line between Piqua and Troy, including the lines of both cities and the line between Dayton and Cincinnati.

CINCINNATI, OHIO.—The project to connect Cincinnati and Toledo by electric railway is rapidly assuming form. Construction on various divisions of the line is well advanced. At a meeting of stockholders, held in Columbus, the following were elected: Ellis Bartholomew, president and general manager; C. H. Wells, first vice-president; A. F. McCormick, second vice-president; I. M. Covault, secretary; Wm. P. Heston, treasurer; Claude Wyant, general counsel. Construction between Columbus and Lima is progressing rapidly.

COLUMBUS, OHIO.—The Commissioners of the county have given the Findlay & Southern Railway company permission to cross the country roads. R. Rosenstock, chief engineer of the road, said that it was the first air line electric railway in the State to operate as does a steam railway. The right of way between Findlay and Columbus has been secured. The power house will be at Kenton, and there will be sub-stations every ten miles. The line passes from Columbus to Toledo through Plain City, Marysville, Unionville, Kenton, Forest and Findlay.

CINCINNATI, OHIO.—Within a few months Cincinnati will be connected with Fort Wayne, Ind., by a continuous electric railroad, which will touch a number of cities and towns, including Hamilton, Dayton, and Richmond, besides several villages suburban to Cincinnati, that are not now connected with the city. The road is to be built by the Fort Wayne, Dayton & Cincinnati Traction Railway Company, which was organized several weeks ago with a capital stock of $1,000,000. The company is completely officered, and has established permanent headquarters in Dayton. Dr. Samuel George, of that city, is president. The company is purchasing its right of way, and arranging for construction work. The length is 356 miles of main line.

OTTAWA, ONT.—An American syndicate has bought Cow Bay Beach, near Halifax, Nova Scotia. An electric railway will be laid from the town of Dartmouth, opposite Halifax, to the beach and a large hotel erected there.

BLOOMSBURG, PA.—The Columbia & Montour Electric Railway has been opened between Bloomsburg and Lime Ridge.

McKEESPORT, PA.—The McKeesport & Suburban Street Railway has been formed to build a line two miles long; capital, $12,000.

MT. JOY, PA.—The Mt. Joy Borough Council has granted the Lancaster & Mt. Joy Railway Company the right to enter the borough.

CHAMBERSBURG, PA.—The Chambersburg Council has granted a franchise to the Chambersburg, Greencastle & Waynesboro Electric Railway Company.

BLOOMSBURG, PA.—The Bloomsburg & Millville Street Railway Company has been formed to run from Bloomsburg to Millville, ten miles; capital, $60,000.

MEADVILLE, PA.—The Meadville & Interurban Street Railway Company has been formed to build sixteen miles of road; capital, $98,000. President, F. R. Shryock, Meadville.

ALTOONA, PA.—The Belt Line Extension Street Railway Company has been formed to build one-half mile of road, beginning at Tenth Avenue and Twelfth Streets; capital, $3,000.

ALTOONA, PA.—The Finance Committee of the City Council has approved the Belt Line trolley ordinance. This means three-cent fares for workingmen. The new company will gridiron the city.

PHILADELPHIA, PA.—At a meeting of the Centre & Clearfield Street Railway Company the capital stock of the company was fixed at $500,000. An issue of an equal amount of 5 per cent thirty-year bonds were authorized.

ERIE, PA.—The Conneaut & Erie Traction Company has been formed to build twenty-five miles of road from the city limits of Erie, through Mill Creek Township, Fairview Township and Borough, Girard Township and Borough, East Springfield Borough and Springfield Township, to the Ohio State line; capital, $150,000.

PITTSBURG, PA.—The stockholders of the Pittsburg and Birmingham Traction Company held their annual meeting and elected the following officers and board of directors: W. L. Mellon, president; A. W. Mellon, vice-president; R. B. Mellon, treasurer; George S. Davidson, secretary and general manager; Weaver H. Rogers, assistant secretary. This is the road which was purchased by the Messrs. Mellon, local bankers, last May, and the new management decided at the last meeting to make a great many improvements upon the newly acquired property. Two hundred thousand dollars will be spent upon 100 new cars, which will all be in operation within four months. It has also been decided to re-lay the tracks along the entire line. The business of the company has shown marked growth during the last year, 11,408,673 passengers having been carried, which is 400,000 more than the year before.

STOCKHOLM, SWEDEN.—The Swedish Government, according to a dispatch from Stockholm to the *Politische Correspondenz*, is considering plans for the installation of electricity throughout the whole railway system of Sweden.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has decided on a complete reconstruction of its system, and will build two new lines to Cameron Hill and Sherman Heights.

WHEELING, W. VA.—Fire at Bridgeport destroyed the Wheeling Traction Company's power house and barns, together with twenty cars, entailing a loss of $50,000.

PARKERSBURG, W. VA.—A company with $500,000 capital has been incorporated to construct and operate an electric railway in Parkersburg and in the surrounding country.

BERLIN, WIS.—Plans are being made, it is said, by the Winnebago Traction Company to build a line through Como to Berlin from Oshkosh.

JANESVILLE, WIS.—P. Spooner, of Madison, has filed an application for a franchise for an electric railway in Janesville, for a term of 50 years. This is the proposed interurban line between Madison and Janesville.

JANESVILLE, WIS.—Mr. H. H. Clough, head of the Beloit, Janesville & Delavan Lake Electric Railway, has let the contract for building the line to Hayes Brothers, of this city. The contract calls for about thirty-five miles of track, which will be commenced at once and must be completed by January 1, 1902.

OSHKOSH, WIS.—The entire plant of the Winnebago Traction Company, including the Oshkosh electric street railway system of seventeen miles, the interurban line of thirteen miles, connecting Oshkosh and Neenah, electric park and park lines of four lines, has been sold to the Milwaukee Electric Railway & Light Company. The sale of the system is important in that it constitutes an important link in the proposed electric railway system from Chicago to Green Bay, a distance of 198 miles, of which lines aggregating 106 miles are now in operation.

THE AUTOMOBILE.

FOREIGN AUTOMOBILES.—Henri Fournier, the celebrated French chauffeur, was among the passengers who arrived last week on the Deutschland. His visit to this country, it is said, is in the interest of a French automobile manufacturing firm which contemplates establishing a branch here, of which Fournier will be the head. The location of the plant has not been decided upon as yet. The motor carriage is a gasoline machine and is of the type that was used by Fournier in some of his races in Europe.

OAKDALE, L. I.—W. K. Vanderbilt, Jr., intends to construct a permanent racing track for motor cycles in the vicinity of Oakdale. His plan as announced is to purchase outright the property needed for the course, to secure absolute privacy. Many of the residents in this section are enthusiastic over the sport of automobiling, and will join heartily with him in his new project. Mr. Vanderbilt's plans are novel, but promise to be most effective. The track is to be constructed with metal bed, and is to be most substantial, as he intends to make it a permanent one. His neighbors have promised to co-operate with him in the construction of the new racing track, and it is presumed that some of the foreign racing machines of high power and great racing capabilities will be brought to this country for speed trials over the path when it is completed.

BUFFALO ENDURANCE TEST.—Among those who have entered for the 500 miles automobile endurance contest from New York to Buffalo this month are President A. R. Shattuck, Elmer Apperson, R. P. Scott, C. R. Grouter, A. R. Townsend, Alexander Dow, A. C. Bostwick, B. B. McGregor, Louis Clarke, Percy Owen, H. R. Winthrop, C. A. Benjamin, W. H. Browning, H. K. Browning, W. K. Vanderbilt, Jr., William Morgan, James Macnaughton, and A. L. McMurtry. Besides these nearly all of the prominent makers of automobiles will be represented by one or more machines. Arrangements have been practically completed for the run from Chicago to Buffalo. This distance is 571 miles, and the run will be made in about eight days. It is expected that fully thirty of the members of the Chicago Automobile Club will make the journey, and most of them will be accompanied by members of their families. The start will be made on Sept. 7.

NEW INDUSTRIAL COMPANIES.

INDIANAPOLIS, IND.—The Richmond, Union City & Portland Interurban Railway Company has filed articles of incorporation. The capital stock is placed at $50.000.

THE COOPER ELECTRIC RAILROAD GATE COMPANY has been incorporated at Dover, Del., with a capital stock of $150,000. The incorporators are Dr. Thomas O. Cooper, of Wilmington; John L. Hall, of Philadelphia, and James F. Dunleavy, of Camden, N. J.

THE SOUTHERN ELECTRICAL SUPPLY COMPANY has been incorporated at Norfolk, Va., with a minimum capital of $10,000. H. W. Summers, of Philadelphia, is president; H. B. Gay, of Baltimore, vice-president; W. J. McBriety, of Norfolk, secretary, and A. N. Palmer, treasurer and general manager.

ALBANY, N. Y.—The Hudson Valley Electric Railway Company has been incorporated, with a capital of $2,600,000. It is a consolidation of the electric railway systems from Troy to Lake George. The officers of the company are Addison B. Colvin, president; Senator George Green, vice-president; Thomas O'Connor, secretary, and F. L. Cowles, treasurer.

LEGAL.

COLUMBUS, OHIO.—The Western Electric Company, of Chicago, has brought suit in the United States Circuit Court, against the Columbus Citizen's Telephone Company, alleging infringement of a patent granted to John Seely on telephone signal appliances, which the plaintiff owns. The petitioner asks for a royalty and an injunction. The Columbus exchange is equipped with apparatus furnished by the Kellogg Switchboard & Supply Company, of Chicago.

ELECTRIC VEHICLE DIVIDENDS.—At Trenton, N. J., on Sept. 3, John Jacob Astor, Martin Maloney, of Philadelphia; George H. Day and other directors of the Electric Vehicle Company, were made defendants in two suits brought in the Court of Chancery by Richard Siegman, of New York, and other stockholders of the concern. It is alleged that the company has paid some $500,000 in unearned dividends, and that in reality the directors have wasted or lost the entire $5,000,000 received in cash for the capital stock, and that they have in addition been compelled to raise $1,500,000 by mortgage to prevent a complete suspension of business. The complainants seek to hold the directors responsible for the alleged illegally paid dividends and to compel an accounting of the funds of the company.

PERSONAL.

MR. JAMES PAXMAN, of Davey, Paxman & Company, engine builders, Colchester, accompanied by Mr. T. H. Harrison, his London manager, is on a visit to the United States.

MR. J. S. O'DONOVAN has resigned as chief electrician of the Republic Iron & Steel Company, and has become chief electrician of the Youngstown, Ohio, Iron Sheet & Tube Company.

MR. R. EMORY, superintendent and general manager of the Nashville Railway & Cumberland Electric Light Company, has resigned in order to become associated in a similar manner with the Milwaukee Railway & Light Company.

Trade Notes.

THE MARSHALL-SANDERS COMPANY, 301 Congress Street, Boston, is supplying a very large demand for the N. M. rosette.

MESSRS. SANDS & WOOD, for some years past connected with some of Colorado's largest power plants, have recently opened an independent office in Denver.

PLANT PURCHASED.—The Minneapolis General Electric Company, Minneapolis, Minn., has gained control of the International Electric Company by purchase.

MR. P. ALBERT POPPENHAUSEN has recently purchased a controlling interest in the Green Engineering Company, of Chicago, of which company he is now president.

THE ELECTRIC APPLIANCE COMPANY has just placed upon the market a new cabinet type wall telephone for both series and bridging work. Special descriptive matter is being sent upon application.

LARGE OIL FILTER.—The Burt Manufacturing Company, of Akron, Ohio, recently installed in the power plant of the Edison Electric Illuminating Company of Brooklyn Borough, New York, one of the largest Cross oil filters ever made.

ASBESTOS PACKING.—A neat little pamphlet about asbestos packing has just been issued by the H. W. Johns Manufacturing Company, New York. The contents are brief and to the point, and include illustrations of characteristic plants where asbestos packings are used.

WITTING BROS., LTD., has been organized in London to carry on business as electrical engineers and contractors at 49 Cannon Street. It is an offshoot of the firm with similar name, which has found it necessary to create a separate concern to attend to that branch of its work.

BULLETINS and prices on Manhattan arc lamps and Pittsburgh transformers can be obtained from the Central Electric Company, of Chicago, which has added these to its long list of standard goods, such as Columbia incandescent lamps, D. & W. safety devices and Okonite wire products.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, is snowed under—in September—with orders. To keep up with the demands for its apparatus, the company is working its factory to the fullest extent day and night, running the entire 24 hours with two gangs of men, one all day and the other all night.

MR. JOHN RAUSCHER, St. Paul, Minn., issues a neat catalogue of his push buttons for electric bells, in a great variety of styles which are all illustrated and described in detail, with prices. He has given great attention to neatness of design and accurate workmanship, and the quotations are remarkably moderate. He will be glad to correspond or send copies of the catalogue.

THE HAINES & NOYES COMPANY, 118 West Jackson Street, Chicago, is putting on the market several new styles of telephones for central energy work and for intercommunicating service. Its non-packing transmitter is guaranteed for five years. It will be glad to send its latest descriptive matter to those who are interested.

OUTPUT PURCHASED.—The Northern Electrical Manufacturing Company of Madison, Wis., has bought the output of the Mechanical Electric Appliance Company, of Milwaukee, which makes small power motors. This action is similar to that of the Milwaukee Electric Company, which recently bought the output of the Browning Manufacturing Company, of Milwaukee, which also makes small power motors.

PAN-AMERICAN BOOKLET.—A booklet intended for distribution at the Pan- American Exposition was recently issued by the Westinghouse companies. It gives a comprehensive idea of the industrial enterprises with which the name "Westinghouse" is associated, and refers to some of the notable work accomplished by the companies. The cover is illuminated very artistically and the illustrations are of high order.

STROBEL & WILKEN COMPANY, 591 Broadway, New York City, are pushing their Yankee searchlight, made up handsomely in torch form. They are also introducing successfully a neat little miniature electric car, which has its motor connected by sprocket and chain to the trucks. The track is sectional and can be added to or shortened up in accordance with battery used, etc. These novelties find a wide and large sale.

PERFECTION IN TELEPHONES.—With this title the Telephone Manufacturing Company, of Sumter, S. C., has issued a neat 32-page pamphlet descriptive of the telephone apparatus of its manufacture. The illustrations show several types of "Imperial" telephone sets, "Imperial" generators and "Imperial" switchboards. These latter range from a small switchboard combined with a telephone set, to a cabinet style for from 20 to 50 circuits, and a station type of 100 lines. This company, however, manufactures to order boards of any size.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the exclusive territorial selling agency for the new type Peerless incandescent lamps. It states that the factory has been experimenting on this lamp for the last two or three years, and to-day it has a lamp which is practically perfect, both mechanically and electrically. It states that its success with this lamp has been extremely flattering, and that it is willing to send out lamps for trial to any one who is on the market for a strictly high grade lamp. It guarantees them fully as to sustained candle power, energy consumption and life.

THE STUART-HOWLAND COMPANY, 279 Devonshire Street, Boston, Mass., is carrying a large stock of electric lighting, telephone and street railway supplies. Its regular weekly inventory, taken on Aug. 14, showed that it had then on hand 27,587 incandescent lamps of over 250 varieties; 4½ carloads (20 tons each) plain cross arm braces, one carload galvanized cross arm braces, four carloads standard cross arms; 337,450 feet of rubber-covered wire in various sizes, and other goods in like proportion. The company's street railway is a very large and expanding one, and its stock of overhead material is complete and ample to meet any demand. Although this company has been in existence only sixteen months it has established a business record of which it may justly feel proud.

AMERICAN ELECTRIC TELEPHONE COMPANY.—In a recent editorial in one of Chicago's dailies, attention was called to the independent telephone movement, mentioning that Philadelphia had contracted for an independent telephone plant. As already noted in these columns, the American Electric Telephone Company secured the contract for practically the entire equipment, with the exception of the switchboard, the remainder of the apparatus including 8000 "Central energy" telephones, 10,000 terminals and all other necessary protective devices. The reason for non-acceptance of the switchboard part, we are informed, is that owing to the large number of previous contracts under construction, the board could not have been completed within the time limit. Harrisburg is another important city in Pennsylvania, with 2000 capacity and provision for 3000. Two small adjoining towns will have 500 line exchanges each, and Reading, Pa., 1500 "central energy," with 5000 ultimate capacity. In New Jersey, Trenton falls in line with 3000 "central energy." Ohio is well represented with Mansfield, common battery, 1200 installed, with 3000 ultimate capacity; Zanesville, Ohio, 1500 common battery connected with provision for 3000. In Xenia, Ohio, the new exchange is running with 800 in operation, designed for 2000. Texas has realized the necessity for modern methods of communication and Austin has contracted for 1200 "central energy" immediate connection, 3000 ultimately; Temple, Tyler and Taylor, each 750 lines, "central energy," ready to connect with double the capacity as subscribers increase in number. Belton, Tex., has bought a 500-line equipment, for common battery, can increase to 1000. Oklahoma City, Ind. Ter., has already 750 subscribers on a 1200 line "central energy" switchboard. Topeka, Kan., will install 1200 lines at once and provide for increase up to 3000. Rhinelander, Wis., will start with nearly 750 subscribers on a 1200 line board. In Illinois, Pekin swells the list with a 750 to 1200 line exchange, while in Huntington, Ind., a 1000 line equipment is contracted for and construction under way.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUG. 27, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

681,185. TELEGRAPHER'S FINGER GUARD; I. H. Blessing, Albany, N. Y. App. filed Nov. 14, 1900. The guard is provided with a projection passing under the finger to overlap the key so that the pressure will be brought on the projection.

681,179. ELECTRIC ARC LAMP; Francis B. Badt, of Chicago, Ill. App. filed Feb. 25, 1901. Relates to an improved support for an arc lamp globe, which may be adapted to any form of arc lamp; and the provision of an improved yielding clamping device for the inner globe of an enclosed arc lamp whereby it may be readily placed in position and adapted to be unseated to permit of the escape of accumulated gas.

681,211. ELECTRIC DETECTOR FOR VALVES; C. G. Garrett, Minneapolis, Minn. App. filed March 20, 1900. A circuit controller is actuated by the valve when it moves to an abnormal position, to sound an alarm.

681,261. AUTOMATIC PIANO; T. B. Powers, New York, N. Y. App. filed April 13, 1899. A system of levers between the magnet armature and the key whereby the stroke of the armature is uniform throughout.

681,268. LAMP SOCKET; D. A. Schutt, Peru, Ind. App. filed July 11, 1900. Details.

681,269. MOTOR CONTROLLER; R. W. Scott, New York, N. Y. App. filed Dec. 19, 1900. Details.

681,290. BURGLAR ALARM; J. B. Yeakle, Baltimore, Md. App. filed June 9, 1900. The system is provided with a double test for conditions, one is applied periodically by the operation of a time-train at the point to be protected and the other by a manually operated key at the central office.

681,293. ELECTRIC SYSTEMS FOR RAILWAYS; D. S. Bergin, Chicago, Ill. App. filed May 23, 1901. A conduit within a conduit, the circuit

being completed by pressure of the plow upon plungers passing through the walls of both conduits.

681,295. DYNAMO ELECTRIC MACHINE; John Balch Blood, of Newburyport, Mass. App. filed March 18, 1901. The invention contemplates an increase in the cross sectional area of the winding with a given cross-section of field and at the same time increasing the circumferential distance around the active coil limbs. One-half of the slots are of one-half the width and twice the depth of the other half of the slots with which they alternate. One-half as many coils as slots are employed; one leg or limb of the coil is one-half the thickness and double the width of the other limb or leg, each coil entering a wide shallow slot at one end and a narrow and deep slot at the other end. With a given magnetic flux and a given induction the heating effect is claimed to be greatly decreased by this method of winding, thereby resulting in a machine of less weight for a given work.

681,296. TELEPHONE RECEIVER SUPPORT LOCK; A. L. Brinckle, Philadelphia, Pa. App. filed May 15, 1901. A lock for holding the receiver hook in a depressed position when the receiver is removed.

681,317. CORE AND POLE PIECE FOR FIELD MAGNETS OF DYNAMOS OR MOTORS; R. Hirsch, Milwaukee, Wis. App. filed Oct. 19, 1899. The polar faces have an area not less than two-thirds of the circumferential area of the armature and a cross-section greater than that of the faces.

681,329. METHOD OF MAKING SECONDARY BATTERY PLATES; B. E. Kuettner, London, England. App. filed Oct. 25, 1900. Mixing lead oxides with a solution of a soluble silicate to form a paste, making the paste into a plate and dipping the plate into a dilute solution of an ammonium salt.

681,341. MAGNETIC DEVICE FOR RESTORING AND AIDING HEARING; S. G. Payn, Jr., Bath-on-Hudson, N. Y. App. filed Jan. 17, 1901. Tubular magnets of opposing polarity adapted to be set into the ears.

681,352. HEATER FOR ELECTROLYTIC INCANDESCENT LAMPS; James Swinburne, of Westminster, Eng. App. filed Jan. 8, 1901. (See Current News and Notes.)

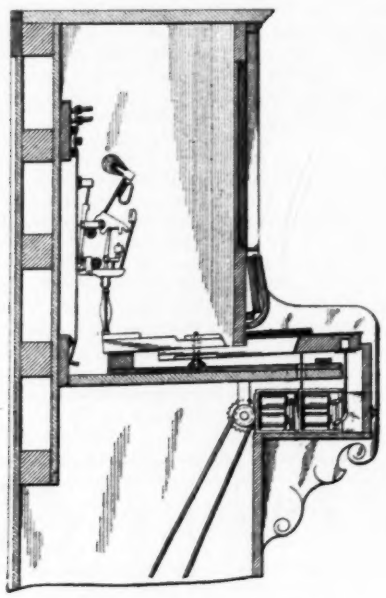
681,353. ELECTRIC SWITCH; G. B. Thomas, Hartford, Conn. App. filed March 5, 1901. Detail.

681,367. REDUCTION OF ORES OR COMPOUNDS; Hugh A. Irvine, of Niagara Falls, N. Y. App. filed Nov. 15, 1898. (See page 373.)

681,371. SIGNALLING APPARATUS; G. E. Painter, Baltimore, Md. To enable patrons to readily signal a car after dark by means of an electric light operated by the trolley current, a switch is arranged to be set by the passenger and restored by the trolley.

681,374. MICROPHONE AND TELEPHONE INSTALLATION; L. Polinsky, Berlin, Germany. App. filed April 3, 1901. A central energy telephone system in which only one main circuit is required for a number of stations.

681,408. ADJUSTABLE ARM FOR SUPPORTING TELEPHONE RECEIVERS; E. M. Cox and W. Reed, Portland, Ore. App. filed Nov. 20, 1900. Details.



681,261.—Automatic Piano.

681,410. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed Jan. 28, 1901. A closed conduit having a series of pockets projecting toward the roadway surface, a conductor in the conduit and armature members projecting from the conductor into the pockets and detachably connected with the conductor.

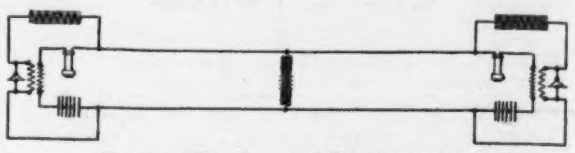
681,416. OUTLET FOR ELECTRIC CONDUCTORS; J. H. Goehst and C. M. Wilkes, Chicago, Ill. App. filed Dec. 17, 1900. The box sets flush with the wall and its watertight cover is provided with a nozzle from which the conductors lead.

681,421. SUPPORTING DEVICE FOR BRUSH HOLDERS; J. P. Mallett, Madison, Wis. App. filed May 10, 1901. A circular support fitting into a recess in the field magnet frame.

681,453. CONTROLLER FOR ELECTRIC RAILWAY MOTOR; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed Sept. 28, 1900. The object is to make it possible to control the power and speed, and also the braking effort of four or more motors by a single drum.

681,461. ATTACHING PLUG FOR ELECTRIC WIRES; L. H. Stuart, Chicago, Ill. App. filed May 1, 1901. Two blocks of non-conducting material, one of which is rotatable relative to the other, and two circuit conductors extending through both blocks.

681,463. APPARATUS FOR TREATING DISEASES; H. E. Waite, New York, N. Y. App. filed March 8, 1901. Electrodes are mechanically vibrated simultaneously with the flow of current, to give a massage treatment as well as the electrical treatment.



681,374.—Microphone and Telephone Installation.

681,470. REMOVABLE JACKET FOR ELECTRIC CABLES; J. Wolff, Chicago, Ill. App. filed Aug. 24, 1900. A waterproof covering connected at its edges and having a tongue bridging the joint between the edges.

681,474. ELECTRO-MAGNETIC SAFETY SYSTEM FOR RAILROAD; C. M. Cronkite, Lansing, Mich. App. filed Aug. 27, 1900. Details of a system in which the location of trains is indicated at a station.

681,532. DIAPHRAGM FOR ELECTRIC BATTERIES; John Laskey Dobell, of Harlesden, Eng. App. filed Dec. 6, 1897. (See Current News and Notes.)

681,555. STEERING MECHANISM FOR GUIDELESS LIFTS; O. Kammerer, Charlottenburg, Germany. App. filed May 11, 1900. A switch and a rheostat are arranged in the car and a series of sliding rails corresponding to the floors are located in the shaft, each rail having a projection adapted to cut out the motor.

681,603. MECHANICAL INTERCOMMUNICATION BETWEEN TELEPHONE SWITCHBOARDS; G. M. Yorke, New York, N. Y. App. filed March 20, 1901. An endless belt for conveying a ticket or paper containing certain information from one board to another.

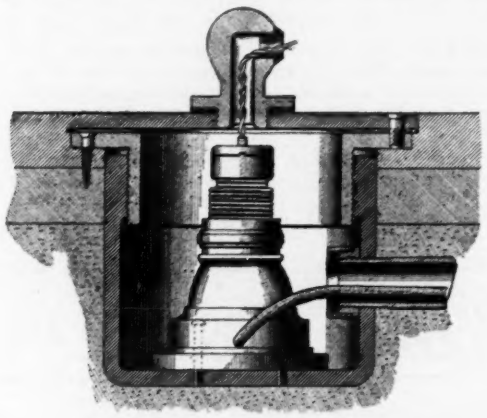
681,604. FEEDER CABLEHOLDER FOR ELECTRIC RAILWAY SYSTEMS; W. D. Young, Baltimore, Md. App. filed Feb. 1, 1901. The cable is confined in a space between the flange of the rail and a loop or bracket embracing the rail.

681,605. CROSS-OVER SWITCH FOR ELECTRIC RAILWAY SYSTEM; W. D. Young, Baltimore, Md. App. filed Feb. 12, 1901. A plurality of separated main conductor rails, one of which is shiftable into the plane of another, and an auxiliary rail separated from the main rails and arranged to span a gap between the main rails.

681,617. TELEGRAPHIC APPARATUS; S. G. Brown, Bournemouth, England. App. filed March 29, 1900. Details.

681,621. FUSE HOLDER; W. R. Cook, Pittsburg, Pa. App. filed Dec. 21, 1900. A magazine fuse-block.

681,625. AUTOMATIC PNEUMATIC REGULATOR FOR MOTORS; W. B. Cowles, Cleveland, Ohio. App. filed May 28, 1901. Details of a system for cutting the pumping motor in and out automatically as the pressure reaches either limit.



681,416.—Outlet for Electric Conductors.

681,637. EXPLOSIVE FIRE ALARM; S. C. Guthrie, Findlay, Ohio. App. filed Dec. 8, 1900. Details.

681,660. PRIMARY BATTERY; O. A. Spahr, Millersburg, Ohio. App. filed June 9, 1900. Details of devices for preventing polarization of the negative plate.

681,664. ELECTRIC PROSPECTING APPARATUS; A. F. McClatchey, Aurora, Ill. App. filed April 20, 1900. The electrodes to be inserted in the earth are provided with means for protecting them from the effects of electrolytic action.